

# Lindsay Creek Watershed Assessment and Total Maximum Daily Loads

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**Public Comment Version**



**Idaho Department of Environmental Quality  
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# **Lindsay Creek Watershed Assessment and TMDLs**

**Public Comment Version**

**Prepared by:  
Lewiston Regional Office  
Idaho Department of Environmental Quality  
1118 F. Street  
Lewiston, Idaho 83501**



## Acknowledgments

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The Idaho Department of Environmental Quality extends our sincere gratitude to the Lindsay Creek Watershed Advisory Group. Their participation was critical to the completion of this document. The result is a water quality improvement plan that allows for a focused and achievable cooperative implementation approach to meeting the goals and requirements of the Idaho State Water Quality Standards and the Federal Clean Water Act.

The Idaho Department of Environmental Quality would also like to thank the Nez Perce Soil and Water Conservation District and Idaho Association of Soil Conservation District personnel. Baseline data collection efforts by both agencies were critical to the development of the TMDLs.

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## Abbreviations, Acronyms, and Symbols

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<b>§303(d)</b>	Refers to section 303 subsection (d) of the Clean Water Act, or a list of impaired water bodies required by this section	<b>F</b>	Fahrenheit
<b>§</b>	Section (usually a section of federal or state rules or statutes)	<b>GIS</b>	Geographical Information Systems
<b>ADB</b>	assessment database	<b>HUC</b>	Hydrologic Unit Code
<b>AU</b>	assessment unit	<b>IDAPA</b>	Refers to citations of Idaho administrative rules
<b>BAG</b>	Basin Advisory Group	<b>km</b>	kilometer
<b>BMP</b>	best management practice	<b>km<sup>2</sup></b>	square kilometer
<b>BOD</b>	biochemical oxygen demand	<b>LA</b>	load allocation
<b>BURP</b>	Beneficial Use Reconnaissance Program	<b>LC</b>	load capacity
<b>C</b>	Celsius	<b>m</b>	meter
<b>cfs</b>	cubic feet per second	<b>m<sup>3</sup></b>	cubic meter
<b>cfu</b>	colony forming unit(s)	<b>mi</b>	mile
<b>cm</b>	centimeters	<b>mi<sup>2</sup></b>	square miles
<b>CWA</b>	Clean Water Act	<b>mg/L</b>	milligrams per liter
<b>CWAL</b>	cold water aquatic life	<b>mm</b>	millimeter
<b>DEQ</b>	Department of Environmental Quality	<b>MOS</b>	margin of safety
<b>DO</b>	dissolved oxygen	<b>n.a.</b>	not applicable
<b>EPA</b>	United States Environmental Protection Agency	<b>NA</b>	not assessed
		<b>NPDES</b>	National Pollutant Discharge Elimination System
		<b>NTU</b>	nephelometric turbidity unit
		<b>PCR</b>	primary contact recreation
		<b>ppm</b>	part(s) per million

<b>QA</b>	quality assurance	<b>TSS</b>	total suspended solids
<b>QC</b>	quality control	<b>t/y</b>	tons per year
<b>SBA</b>	subbasin assessment	<b>U.S.</b>	United States
<b>SCR</b>	secondary contact recreation	<b>WAG</b>	Watershed Advisory Group
<b>TDS</b>	total dissolved solids	<b>WBAG</b>	Water Body Assessment Guidance
<b>TIN</b>	total inorganic nitrogen	<b>WBID</b>	water body identification number
<b>TKN</b>	total kjeldahl nitrogen	<b>WLA</b>	wasteload allocation
<b>TMDL</b>	total maximum daily load	<b>WQLS</b>	water quality limited segment
<b>TP</b>	total phosphorus	<b>WQS</b>	water quality standard
<b>TS</b>	total solids		

## Executive Summary

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The federal Clean Water Act requires that Idaho restore and maintain the chemical, physical, and biological integrity of state waters. Idaho, pursuant to Section 303 of the Clean Water Act, is to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible. Section 303(d) of the Clean Water Act requires Idaho to identify and prioritize water bodies that do not meet water quality standards. Idaho must periodically publish a priority list of impaired waters in an Integrated Report. Currently this report must be published every two years. For waters reported as not meeting water quality standards, Idaho must develop a total maximum daily load plan to meet water quality standards.

This document addresses the water quality problems in the Lindsay Creek watershed that were included in Idaho's 2002 Integrated Report.

This subbasin assessment (SBA) and total maximum daily load (TMDL) analysis have been developed to comply with Idaho law and the federal Clean Water Act. The assessment describes the water quality status and pollutant sources of Lindsay Creek located near Lewiston, Idaho. Two segments of the Lindsay Creek watershed were reported on the 2002 303(d) list. This assessment explains the current status of Lindsay Creek and defines the extent and causes of water quality problems in the watershed. The total maximum daily loads (TMDLs) quantify existing pollutant loads and allocate responsibility for load reductions needed to meet state water quality standards.

### Subbasin at a Glance

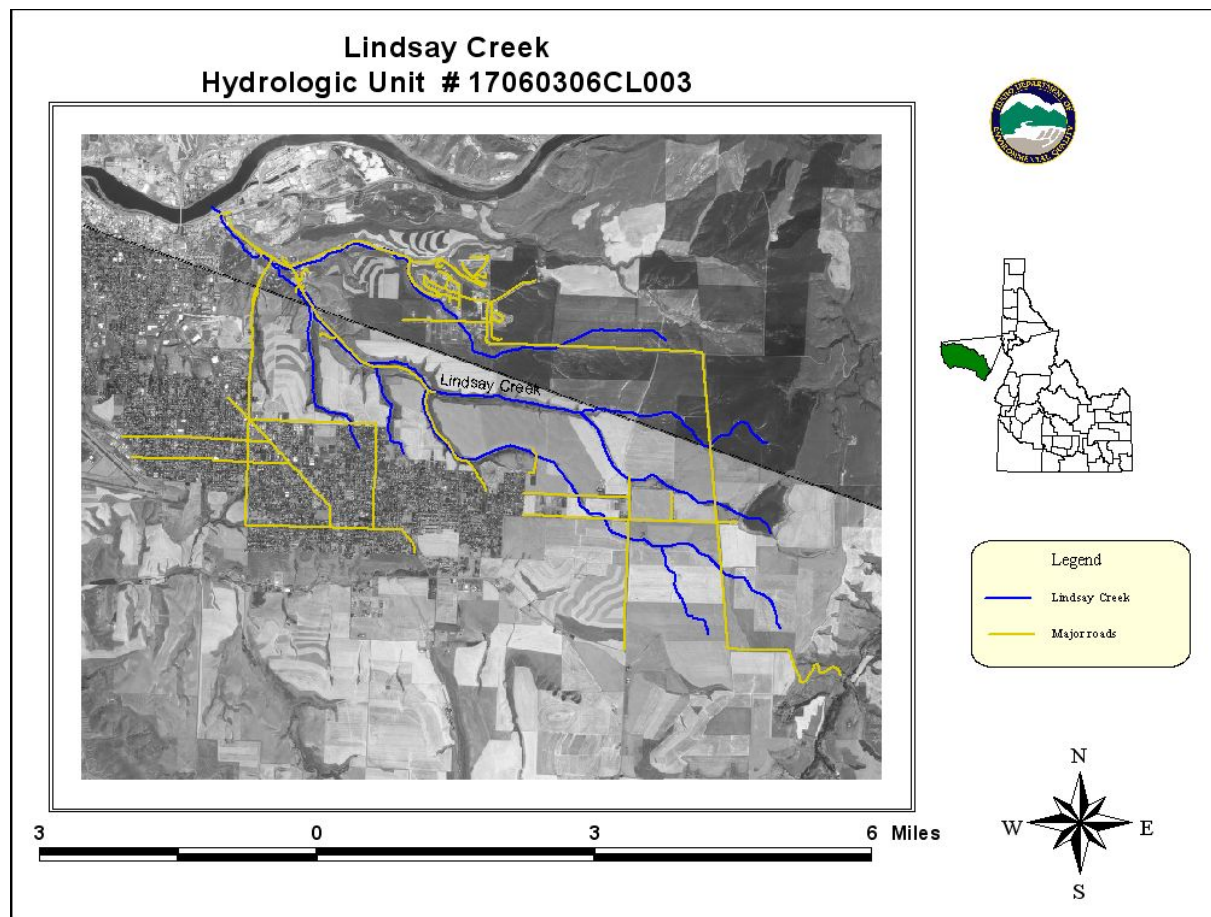
Lindsay Creek is a third order tributary to the Clearwater River, a part of Hydrologic Unit Code (HUC) 17060306. Lindsay Creek is a small watershed encompassing approximately 14,200 acres (Figure A). The main stem of Lindsay Creek originates from springs at the wetland just below Mann's Reservoir and flows northwest to its confluence with the Clearwater River in Lewiston, Idaho.

Creek elevation varies from approximately 1,800 feet above sea level at the headwaters to approximately 750 feet near the confluence. The creek flows through farmland in the upper reaches and then through a canyon until it passes into a tunnel drain through the Clearwater Levee built by the Army Corps of Engineers as part of the Lower Granite Dam project. The drainage area of the Lindsay Creek watershed is approximately 22 square miles. The creek's main stem is approximately 8 miles long and its tributaries, both intermittent and perennial, are approximately 19 miles long.

Primary land uses in the watershed consist of dry land agriculture, small cattle operations, and a small suburban area in the northeast section of Lewiston, Idaho.

### Assessment Unit Split Based on Land Use

To characterize comparable segments for assessment purposes, AU 17060306CL003\_02 has been split based on land use considerations: 17060306CL003\_02 begins at the wetland located directly below Mann's Reservoir dam and is considered the headwaters of Lindsay Creek. Mann's Reservoir is AU 17060306CL003\_02a. Lindsay Creek is identified as Assessment Units (AUs) 17060306CL003\_02 and ID17060306CL003\_03 in the Idaho DEQ water body identification system.



**Figure A. Lindsay Creek Watershed**

### **Key Findings**

Lindsay Creek was originally listed as not meeting state water quality standards on the 1998 303(d) list. Pollutants of concern included sediment, nutrients, bacteria, stream temperature, dissolved oxygen, and flow alteration and habitat alteration.

Since flow alteration and habitat alteration are not pollutants that can be quantified and allocated for loadings, total maximum daily loads (TMDLs) were not developed for them. It is recommended that the listings for flow alteration and habitat alteration for Lindsay Creek

be moved from Section 5 to Section 4c of the 2006 Idaho Integrated Report since TMDLs can only be developed for pollutants that can be quantified.

### Water Quality Sampling

A water quality sampling project was conducted by Idaho Association of Soil Conservation Districts personnel from February 27, 2001 to February 25, 2002. Parameters sampled for included total phosphorus, ortho-phosphate, nitrite+nitrate-nitrogen, *E. coli* and total coliform bacteria, total suspended solids, turbidity, specific conductance, pH, percent dissolved oxygen saturation, temperature, flow and dissolved oxygen. Instantaneous sampling occurred approximately every two weeks at six sites throughout the watershed.

The established sites are shown in Figure 5 (page 22). Additional monitoring and analyses were conducted in 2005 and 2006 by DEQ personnel to fill data gaps (see 2.5 Data Gaps).

### *E. coli* TMDL

Forty-one percent of the *E. coli* bacteria samples collected during the 2001-2002 monitoring season were measured and found to be above Idaho's instantaneous water quality criterion, defined in IDAPA 58.01.02.251. Water quality monitoring conducted in 2005 showed *E. coli* bacteria in Lindsay Creek were above Idaho's water quality standard.

Consequently, an *E. coli* bacteria TMDL was developed and allocated a concentration equal to the state standard to all nonpoint sources contributing *E. coli* bacteria to the Lindsay Creek watershed. As such, all contributing sources should be reduced by 66% (Table A).

**Table A. *E. coli* load allocation.**

Pollutant	Target	Sampling Site ID #	Existing Load	Target Load Capacity	Load Reduction
<i>E. coli</i> Bacteria	126 cfu/100ml	LZ-1	366 cfu/100 ml	126 cfu/100ml	66%

In agricultural areas, the most common source of bacteria is from livestock and wildlife. Livestock manure from pastures, rangelands, and barnyards can contribute bacteria to the creek through overland runoff. Septic systems can also contribute bacteria if they are in close proximity to the creek. Pets can contribute bacteria to the creek too.

### Nutrient TMDL

Ground water flow to Lindsay Creek is significant year round, and nitrogen concentrations in ground water are typically measured as nitrite plus nitrate as nitrogen (nitrite+nitrate-N). Nitrite (NO<sub>2</sub>) is a compound that is short an oxygen molecule comparatively, and when exposed to oxygen changes to nitrate (NO<sub>3</sub>).

Measured nitrite plus nitrate as nitrogen (nitrite+nitrate-N) concentrations in samples collected from Lindsay Creek ranged from below the analytical detection limit at site LZ-6 to 11.0 mg/L at site LZ-4. The collective average was 4.85 mg/L. The largest range in concentrations was seen at LZ-4, while the lowest range was near the headwaters at site LZ-6. (IDAPA 58.01.11, *Ground Water Quality Rule*, Section 200, defines the Idaho criteria for nitrate as nitrogen as 10 mg/L.)

High dominance by the functional feeding groups identified in Lindsay Creek—those that feed on fine particulate organic matter—indicated possible environmental stress from organic inputs to the stream. Elevated nutrient levels in Lindsay Creek appear to originate within the watershed and from ground water springs entering the watershed. Nitrogen concentrations in the groundwater indicate impacts are occurring to ground water quality, causing nitrogen concentrations to exceed the ground water management action threshold. (There are no indications that total phosphorus or nitrite+nitrate-N concentrations have seasonality, as values remained constant with the exception of the total phosphorous spike events noted in Section 2.3.).

Accordingly, a nutrient TMDL (Table B) was developed to initiate protective ground water quality management actions, reduce nitrogen loading to the creek, and address the effects on cold water aquatic life in the creek.

In agricultural areas, the application of fertilizers to crops can be a source of nutrient loading to water by percolation through the soil or from runoff. Soil reaching the creek can add both phosphorous and nitrogen to the stream. Manure from pets, wildlife, and livestock can contribute nutrients to the creek as well.

The movement of nutrients to the creek occurs by rainfall runoff, groundwater draining to the creek, and constructed drainage systems. Nutrients in the creek can be used up by algae and microorganisms or adsorbed to particles and sediment in the water.

Considering that Lindsay Creek nutrient concentrations can only be as low as the concentrations in the ground water that feed it, the target used to develop the total maximum daily load is based on a concentration considered to be normal for Idaho groundwater. Naturally occurring concentrations of nitrite plus nitrate, ( $\text{NO}_2 + \text{NO}_3$ ) typically do not exceed 2 mg/L and concentrations exceeding this level are considered to be outside the range of natural conditions (IDWR 1995).

## TMDL Implementation Plan

Table C summarizes the assessment outcomes. An implementation plan will be developed through consultation with the Lindsay Creek Watershed Advisory Group and supporting agencies. The implementation plan should provide the actions necessary to reduce *E. coli* bacteria and nutrients in Lindsay Creek to comply with Idaho water quality standards and attain full support of its designated beneficial uses.

**Table B. Nitrite+nitrate-N load allocation.**

<b>Month</b>	<b>Average Concentration (mg/L)</b>	<b>Average Flow (cfs)</b>	<b>Existing Load (lbs/month)</b>	<b>Load Capacity (lbs/month)</b>	<b>Load Allocation (lbs/month)</b>	<b>Load Reduction (%)</b>
<b>January</b>	6.70	3.44	3728	1113	1057	72
<b>February</b>	6.33	4.25	4351	1374	1305	70
<b>March</b>	6.15	4.61	4588	1492	1417	69
<b>April</b>	5.45	4.92	4338	1592	1512	65
<b>May</b>	5.70	3.64	3353	1177	1118	67
<b>June</b>	3.45	3.52	1963	1138	1081	45
<b>July</b>	6.35	3.31	3403	1072	1018	70
<b>August</b>	6.05	2.28	2232	738	701	69
<b>September</b>	6.80	2.32	2547	749	712	72
<b>October</b>	5.80	3.16	2968	1023	972	67
<b>November</b>	6.20	3.20	3203	1033	982	69
<b>December</b>	6.45	3.62	3774	1170	1112	71

**Table C. Summary of assessment outcomes.**

<b>Water Body Segment/AU #</b>	<b>Pollutant</b>	<b>TMDL(s) Completed</b>	<b>Recommended Changes to Integrated Report</b>	<b>Justification</b>
Lindsay Creek 17060306CL003_02 & _03	Bacteria	Yes	Move to Section 4a	TMDL Completed
Lindsay Creek 17060306CL003_02 & _03	Temperature	No	Remove as Pollutant	Data demonstrates that the applicable WQS is being met
Lindsay Creek 17060306CL003_02 & _03	Dissolved Oxygen	No	Remove as Pollutant	Data demonstrates that the applicable WQS is being met
Lindsay Creek 17060306CL003_02 & _03	Sediment	No	Remove as Pollutant	Data demonstrates that the applicable WQS is being met
Lindsay Creek 17060306CL003_02 & _03	Nutrients	Yes	Move to Section 4a	TMDL Completed
Lindsay Creek 17060306CL003_02 & _03	Flow Alteration	No	Move to Section 4c	Pollutant vs. Pollution
Lindsay Creek 17060306CL003_02 & _03	Habitat Alteration	No	Move to Section 4c	Pollutant vs. Pollution

## Public Participation

This TMDL has been developed with the assistance of the Lindsay Creek Watershed Advisory Group. The Watershed Advisory Group was recommended by the Clearwater Basin Advisory Group in January 2006, appointed by the Department Director in February 2006, and organized in April 2006.

The Watershed Advisory Group represents agriculture, local government, federal government, the Nez Perce Tribe, recreation, forestry, point source discharges, environmental, mining, livestock, and residential interests. The Watershed Advisory Group has met, and through their established operating procedures, provided concurrence to complete this draft TMDL.

# 1. Subbasin Assessment – Watershed Characterization

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The federal Clean Water Act requires that Idaho restore and maintain the chemical, physical, and biological integrity of state waters. Idaho, pursuant to Section 303 of the Clean Water Act, is to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the state's waters whenever possible. Section 303(d) of the Clean Water Act requires Idaho to identify and report waters that do not meet state water quality standards every two years. For waters that are listed, Idaho must develop a total maximum daily load (TMDL) plan to reduce the pollutant loads causing the non compliance and restore the water to comply with water quality standards.

This document includes a watershed characterization, the water quality status, a pollutant inventory, and a summary of past and present pollution control efforts for the Lindsay Creek watershed to date. This information was used to develop a TMDL—an estimate of the maximum amount of a pollutant that can be present in a water body and still meet water quality standards—for each pollutant found to exceed Idaho's water quality standards.

## 1.1 Introduction

In 1972, Congress passed the Federal Water Pollution Control Act, more commonly called the Clean Water Act. The goal of this act was to “restore and maintain the chemical, physical, and biological integrity of the Nation's waters.”

The Department of Environmental Quality (DEQ) is responsible for compliance with the Clean Water Act in Idaho. The U.S. Environmental Protection Agency is responsible to ensure Idaho's water quality program complies with the Clean Water Act.

Section 303 of the Clean Water Act requires DEQ to adopt water quality standards and to review those standards every three years. The Environmental Protection Agency must approve Idaho's water quality standards. In addition, DEQ must monitor state waters to identify those not meeting state water quality standards; these impaired waters are included on what is called the 303 (d) list. A TMDL must be completed for each water body not meeting water quality standards to restore the water body and comply with the standards.

Section 2 of this document includes an evaluation and summary of the current water quality status, pollutant sources, and control actions in the Lindsay Creek watershed to date. While the assessment is not a requirement of the total maximum daily load, the assessment is required by Idaho state law.

Idaho water quality standards address various beneficial uses designated or presumed for specific water bodies, defining the corresponding numeric and narrative physical and chemical limits, or criteria, needed to support the uses. These beneficial uses are identified in the Idaho water quality standards, IDAPA 58.01.02, and include the following:

- Aquatic life support—cold water, seasonal cold water, warm water, salmonid spawning, modified
- Contact recreation—primary, secondary

- Water supply—domestic, agricultural, industrial
- Wildlife habitats
- Aesthetics

The Idaho legislature designates uses for water bodies. Industrial water supply, wildlife habitats, and aesthetics are designated beneficial uses for all water bodies in the state. If a water body is unclassified, then cold water and primary contact recreation are assumed to be designated uses when water bodies are assessed.

## **1.2 Physical and Biological Characteristics**

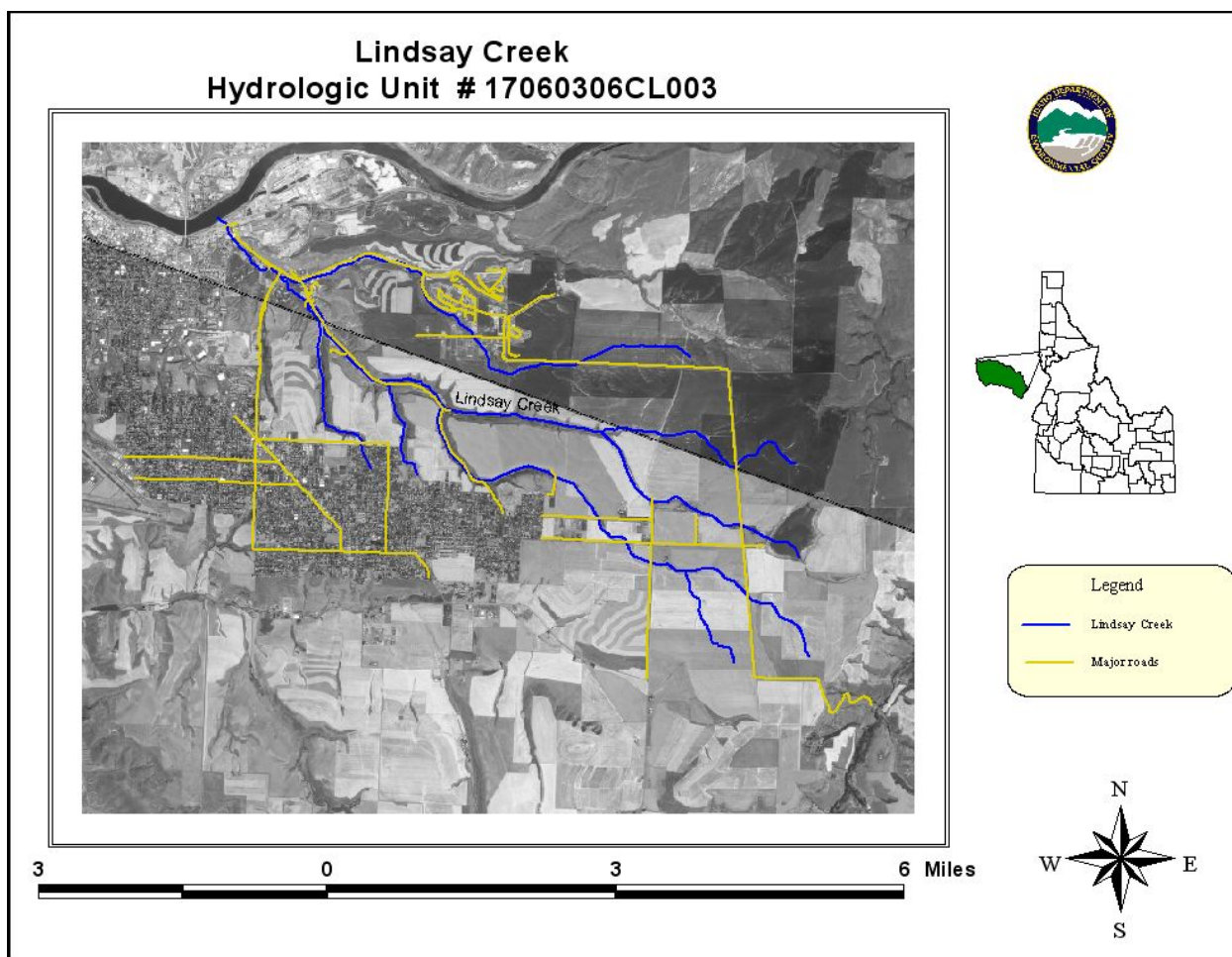
Lindsay Creek is a third order tributary to the Clearwater River, a part of Hydrologic Unit Code 17060306. Lindsay Creek is a small watershed encompassing approximately 14,200 acres (Figure 1). The main stem of Lindsay Creek originates from springs at the wetland just below Mann's Reservoir, and flows northwest to its confluence with the Clearwater River in Lewiston, Idaho.

Creek elevation varies from approximately 1,800 feet above sea level at the headwaters to approximately 750 feet near the confluence. The creek flows through farmland in the upper reaches through a canyon, until it passes into a tunnel drain through the Clearwater Levee built by the Army Corps of Engineers as part of the Lower Granite Dam project. The drainage area of the Lindsay Creek watershed is approximately 22 square miles. The creek's main stem is approximately 8 miles long, and its tributaries, both intermittent and perennial, are approximately 19 miles long.

### **Climate**

North Central Idaho is dominated by Pacific maritime air masses and prevailing westerly winds. Over 85% of the annual precipitation occurs during late fall, winter, and spring months. Cyclonic storms, consisting of a series of frontal systems moving east, produce long duration, low-intensity precipitation during this period of the year. In winter and spring, this inland maritime regime is characterized by prolonged gentle rains, fog, cloudiness, and high humidity, with deep snow accumulations at higher elevations. Winter temperatures here are often 15 to 25 °F warmer than continental locations of the same latitude.

The Lindsay Creek watershed is located in a semi-arid area, where summer months are hot and dry, with rainfall stemming from occasional thunderstorms and brief heavy precipitation events.



**Figure 1. Lindsay Creek Watershed**

For the years 1948 through 2004, the average maximum air temperature for the months of June through September was 83.4 °F, with an average minimum temperature of 55.1 °F. For the same months, the average monthly precipitation was 0.87 inches, with a total average precipitation of 3.48 inches, or 27% of the total annual precipitation. Mean annual precipitation in Lewiston, Idaho is 12.73 inches (Western Regional Climate Center 2005).

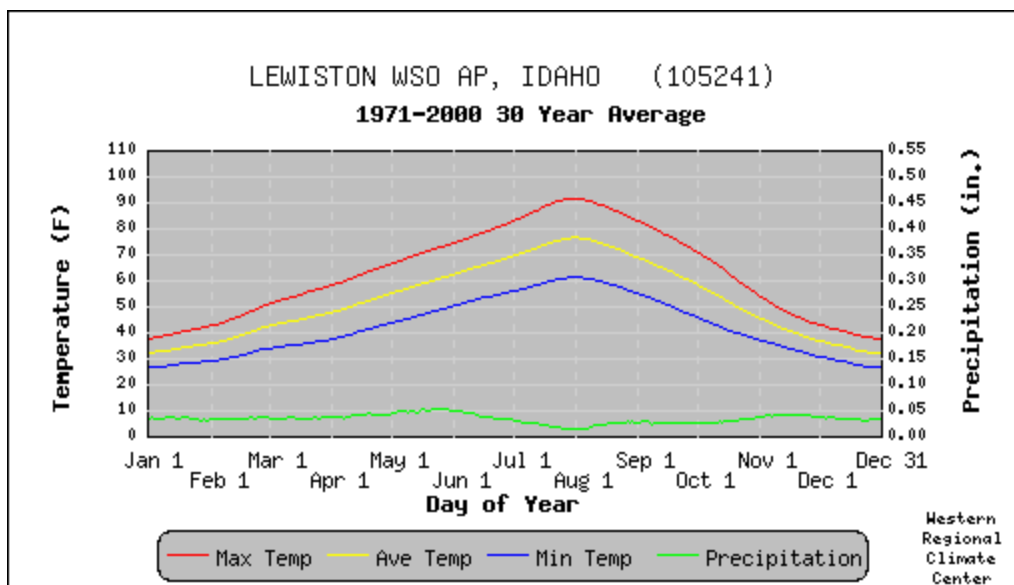
The winter months, December through March, are usually cool with approximately 35% of the annual precipitation occurring during this period. The average maximum temperature for the years 1948 through 2004 was 45 °F, while the average minimum temperature was 30.1 °F during the winter season. The average monthly precipitation during winter was 1.09 inches. The average total winter precipitation was 4.37 inches, with an average annual snowfall of 15.8 inches (Western Regional Climate Center 2005).

Table 1 shows the annual average temperature and precipitation for 1948 through 2004. Figure 2 displays the 30-year averages (1971-2000) of temperature and precipitation for Lewiston, Idaho (Western Regional Climate Center 2005).

**Table 1. Climate summary for Lewiston, Idaho.**

Station Name	Source 1	Elevation (feet)	Period of Record	Mean Annual Temperature (°F)	Mean Annual Precipitation (inches)
Lewiston WSO AP (105241)	WRCC	1440	8/1/1948-12/31/2004	52.5	12.73

1WRCC = Western Regional Climate Center



**Figure 2. 30-Year Averages for Air Temperature and Precipitation in Lewiston, Idaho (WRCC 2005)**

### Geology and Soils

The majority of the text in this subsection is taken directly from the Surficial Geologic Map of the Lewiston Orchards North Quadrangle and Part of the Clarkston Quadrangle, Nez Perce County, Idaho (Othberg et al. 2003). The surficial deposits in the watershed are categorized into five separate units. Figure 3 provides a general representation of the surficial geology/soils of the watershed.

**Unit 1: Loess (Holocene and Pleistocene)** Loess soil extends to the upper plateau of the Lindsay Creek watershed and eastern sections of the Lewiston Orchards, occupying approximately 72% of the watershed. The soil is composed of calcareous wind-blown silt, sandy near deposits of the Lake Missoula Floods. Composition partly correlates with the Palouse Formation; however, it lacks the distinctive Palouse Hills of the eastern Columbia group, and is composed of a single late Pleistocene deposit. Exposures show one to several layers that represent periods of rapid depositions of air-borne dust. The

thickest layers of loess material may have formed immediately after the Lake Missoula Floods backwater events in the Clearwater and Snake River valleys. Soil thickness is 5 to 20 feet and may be greater than that on some north-facing slopes where it is thickened by wind drift and where vegetation prevents erosion.

**Unit 2: Alluvium of Side Streams (Holocene)** This unit is composed of channel and flood-plain deposits of tributaries to the Clearwater River. It consists primarily of coarse gravels deposited during high-energy stream flows, with subrounded to rounded boulders, cobbles, and pebbles of basalt in a sand matrix. It includes intercalated colluvium and debris-flow deposits from steep side slopes. Soils developed inside-stream alluvium include the Bridgewater and Lapwai soil series.

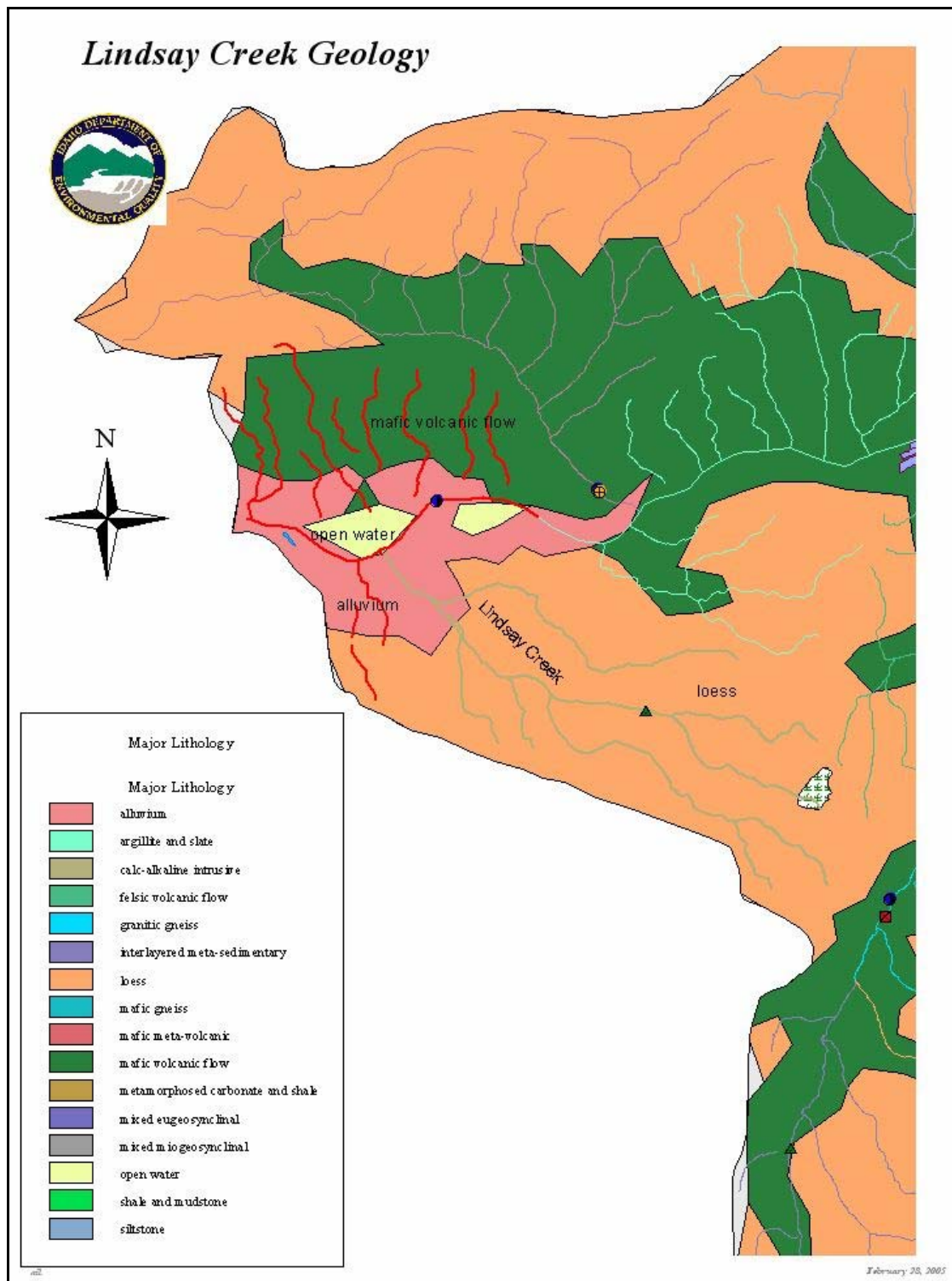
**Unit 3: Colluvium from Basalt (Holocene and Pleistocene)** These areas contain primarily poorly sorted brown muddy gravel composed of angular and subangular boulders, cobbles, and pebbles of basalt in a matrix of silt and clay. Deposits have been emplaced by gravity movements on steep-sided canyons and gullies cut into Columbia River basalt. Steep, dry, southerly aspects commonly contain outcrops of basalt where colluvium is thinner and the more erosion-resistant basalt flows from laterally traceable edges. More gently sloping areas are covered with thin loess, typically 1-5 feet thick, particularly close to boundaries with loess units.

**Unit 4: Alluvium and Colluvium (Holocene)** Areas within this unit consist of stream, slope-wash, and gravity deposits. Predominately beds of silt, clay, and sand received through the erosion of bordering depositional units. Stream deposits are characteristically thin and interfinger with laterally thickening deposits of slope wash and colluvium derived from local loess deposits and weathered basalt. Soils developed in these deposits include the Broadax and Slickpoo series.

**Unit 5: Landslide Deposits (Holocene and Pleistocene)** This unit contains poorly sorted and poorly stratified angular basalt cobbles and boulders with silt and clay. Landslide deposits include debris slides as well as blocks of basalt, sedimentary interbeds that have been rotated and moved laterally. Debris slides mainly composed of unstratified, unsorted gravel rubble in a clayey matrix.

## Hydrogeology

Multiple aquifers underlying the area occur within the basalt flows of the Columbia River Group. Lacustrine (lake) and fluvial (river) sediments of the Latah Formation are interbedded among the basalt flows. Ground water in the area occurs within three aquifers: an Upper, Intermediate, and Lower (IDWR 1999).



**Figure 3. Major Lithology of the Lindsay Creek Watershed**

Because of concerns that water use may exceed recharge in the shallow upper aquifer, a Lindsay Creek Ground Water Management Area was designated in the area south of the Clearwater River and east of Lewiston on March 5, 1992. Eleven wells in the area are measured routinely to track measured changes in ground water levels.

The Upper Aquifer is associated with water bearing zones and sediments to a depth of approximately 700 feet beneath land surface. Underflow that enters from the east appears to be the primary source of recharge. The shallow portion of the Upper Aquifer occurs at depths of 120 to 150 feet beneath ground surface, with the base of the shallow aquifer at approximately 250 feet. The major rock type is basalt and yields from domestic wells are usually less than 25 gallons per minute. Ground water flows generally westward with a slight northwest component following the slope of the land (IDWR 1999).

Depths of the Intermediate Aquifer occur 700 to 1100 feet beneath the ground surface. Recharge occurs through outcrops of basalt interflow zones in the channel and flood plain area of the Clearwater River, Snake River, Lapwai Creek, and through ancestral channels buried by Upper Yakima Valley filling flows.

Recharge to the Lower Aquifer occurs mostly from the Clearwater River, Snake River, and Lapwai Creek, with depths of the Lower Aquifer at 1100 feet below land surface (IDWR 1999).

### Subwatershed Characteristics

The Lindsay Creek watershed can be divided into two smaller watersheds based on hydrology: South Fork Lindsay Creek and East Fork Lindsay Creek. Other ephemeral creeks within the watershed contribute flow to Lindsay Creek in the winter and spring but are generally dry all summer.

The South Fork Lindsay Creek is a second order tributary that flows 5.9 stream miles to its confluence with Lindsay Creek near Lindsay Creek Road (Figure 5, page 22), changing the main stem to third order. Annual flows in the creek averaged 0.28 cubic feet per second (cfs) during the 2001-2002 monitoring season, or approximately 8% of the annual flow within the watershed. The geology and soil deposits mirror the upper Lindsay Creek reaches dominated by rich loess soil.

The East Fork Lindsay Creek is a first order tributary and drains adjacent to Lapwai Creek Road (Figure 5, page 22) flowing 5.6 stream miles to its confluence with the main stem. The geology consists mainly of alluvium and colluvium deposits in and near the stream bed. Average annual flow from the 2001-2002 monitoring season was 0.15 cfs, averaging 4% of the annual flow to Lindsay Creek.

### Mann's Reservoir

Mann's Reservoir, also known as Reservoir "A" Dam, is an off stream reservoir located approximately seven miles southeast of Lewiston. The basin of the reservoir is a shallow, round-bottomed, erosional valley in a plateau near the headwaters of Lindsay Creek (USBR 2005).

The reservoir was constructed in 1907 as part of the larger Lewiston Orchards Project and has a total capacity of 1,960 acre feet of water (Metz 2005). Originally a domestic and irrigation water supply, the water is now used for irrigation and fire protection for local and county residents. The reservoir is also a recreational facility for fisherman and avian observers. Fish species in the reservoir include stocked rainbow trout, catfish, largemouth bass, black crappie, and bluegill.

No intentional discharge from Mann's Reservoir (Assessment Unit 17060306CL003\_02a) enters Lindsay Creek. However, a leachate collection system exists to capture dike seepage. The leachate drains to a wetland at what is considered the headwaters of Lindsay Creek (Assessment Unit 17060306CL003\_02).

Lewiston Orchard Irrigation District (LOID) personnel use flumes and weirs to collect flow measurements on a routine basis to quantify dike seepage. Measurements taken on March 28, 2006 show that approximately 0.051 cfs (~33,000 gallons/day) seeped from the dike. This volume may represent a typical daily average for the month of March; however, the volume of leachate through the collection system increases and decreases as a result of fluctuating levels in the reservoir.

DEQ personnel attempted to collect nitrite+nitrate as nitrogen (NO<sub>2</sub>+NO<sub>3</sub>-N) and *E. coli* bacteria samples of the leachate in May 2006 to determine the existing concentrations of these parameters in relation to Idaho water quality standards. However, flow out of the toe drains was too minimal to collect water samples. Future monitoring within the watershed should determine if this data gap should be quantified.

### **1.3 Cultural Characteristics**

#### **Land Ownership and Use**

The City of Lewiston is the only city in the watershed, with a majority of the watershed located in the northwest section of Nez Perce County, Idaho. Approximately 72% of the land in the Lindsay Creek watershed is used for non-irrigated agriculture (IASCD 2002). The lower segments of the watershed flow adjacent to city and county roads through suburbanized areas of Nez Perce County and the City of Lewiston where land uses vary from residences and small ranches to industrial based businesses.

#### **History, Economics, and Population**

Lewiston resides at the lowest elevation in the state at the confluence of the Snake and Clearwater Rivers, approximately 460 river miles from the Pacific Ocean. The area provided the Nez Perce Tribe and European settlers with a pleasant location for winter residences relative to surrounding areas.

Currently, the Lewis-Clark valley population is approximately 50,000 and is home to Idaho's only seaport, the furthest inland port on the west coast. Nearly one million tons of wheat and

barley, and large amounts of pulp, paper, and wood products are shipped through the port on an annual basis. The Lewis-Clark valley is supported by industrial manufacturing, retail stores, various businesses, and recreational outfitters.



## 2. Subbasin Assessment-Water Quality Concerns and Status

Lindsay Creek Assessment Unit #s ID17060306CL003\_02 and ID17060306CL003\_03 were listed as not meeting state water quality standards on the 2002 §303(d) list. Section 303(d) of the Clean Water Act states that waters that do not meet water quality standards are required to have total maximum daily loads developed to bring them into compliance with water quality standards.

Pollutants suspected of affecting Lindsay Creek are bacteria, dissolved oxygen, nutrients, sediment, stream temperature, and flow alteration and habitat alteration. Since flow alteration and habitat alteration are not pollutants that can be quantified and allocated for loadings, TMDLs will not be developed for them. Table 2 shows the details of the 2002 §303(d) listing information for Lindsay Creek.

**Table 2. 2002 §303(d) listing information for Lindsay Creek.**

Water body Name	Water Body ID Number	2002 §303(d) Boundaries	Pollutants	Listing Basis
Lindsay Creek	03	Headwaters to Clearwater River	BAC, DO, NUT, SED, TEMP, HALT, FALT	2002 §303 “d” list

BAC = Bacteria, DO = Dissolved Oxygen, NUT = Nutrients, SED = Sediment, TEMP = Temperature, HALT= Habitat Alteration, FALT= Flow Alteration

### 2.1 About Assessment Units

Assessment units (AUs) now define all the waters of the state of Idaho. These units and the methodology used to describe them can be found in the Waterbody Assessment Guidance, Second Edition (Grafe et al. 2002). Assessment units are groups of similar streams that have similar land use practices, ownership, or land management. Stream order, however, is the main basis for determining AUs. Although ownership and land use can change significantly, the AU remains the same.

Using AUs to describe water bodies offers many benefits, the primary benefit being that all the waters of the state are now defined consistently. In addition, using AUs fulfills the fundamental requirement of EPA’s 305(b) report, a component of the Clean Water Act wherein states report on the condition of all the waters of the state. Because AUs are a subset of water body identification numbers, there is now a direct tie to the water quality standards for each AU, so that beneficial uses defined in the water quality standards are clearly tied to streams on the landscape.

However, the new framework of using AUs for reporting and communicating needs to be reconciled with the legacy of 303(d) listed streams. Due to the nature of the court-ordered 1994 303(d) listings, and the subsequent 1998 303(d) list, all segments were added with boundaries from “headwater to mouth.” In order to deal with the vague boundaries in the listings, and to complete TMDLs at a reasonable pace, DEQ set about writing TMDLs at the watershed scale (HUC), so that all the waters in the drainage are and have been considered for TMDL purposes since 1994.

Beginning in 2002, the U.S. Environmental Protection Agency combined Section 303(d) and 305(b) reporting requirements into an Integrated Report. The Integrated Report contains five sections that categorize water quality conditions relative to Section 303(d) and 305(b) of the Clean Water Act.

Sections 1 and 2 of the Integrated Report list water bodies that are attaining all (Section 1) or some (Section 2) of Idaho water quality standards. Section 3 lists water bodies with insufficient data and information to determine if any standards are attained. Section 4 corresponds to water bodies that are impaired or threatened for one or more standards but not needing a TMDL (de-listed). Section 5 corresponds to waters needing a TMDL (303(d)).

The boundaries from the 1998 303(d) listed segments have been transferred to the new AU framework, using an approach quite similar to that used by DEQ to write SBAs and TMDLs. All AUs contained in the listed segment were carried forward to the 2002 303(d) listings in Section 5 of the Integrated Report. AUs not wholly contained within a previously listed segment, but partially contained (even minimally), were also included in Section 5 of the Integrated Report. This was necessary to maintain the integrity of the 1998 303(d) list and to maintain continuity with the TMDL program. These new AUs will lead to better assessment of water quality listing and de-listing.

When assessing new data that indicate full support, only the AU that the monitoring data represents will be removed (de-listed) from the 303(d) list (Section 5 of the Integrated Report).

## **2.2 Applicable Water Quality Standards**

Idaho has both narrative and numeric water quality standards to protect public health and water quality. Designation of beneficial uses for water bodies sets the criteria necessary to protect those uses. According to IDAPA 58.01.02.050 (02)a “wherever attainable, surface waters of the state shall be protected for beneficial uses which includes all recreational use in and on the water surface and the preservation and propagation of desirable species of aquatic biota.”

Beneficial use support is determined by the Department of Environmental Quality through its water body assessment process. Table 3 contains a listing of designated beneficial uses for Lindsay Creek. Table 4 summarizes water quality standards associated with the beneficial uses and the pollutants of concern.

**Table 3. Lindsay Creek designated beneficial uses.**

<b>Water Body</b>	<b>Designated Uses<sup>1</sup></b>	<b>1998 §303(d) List</b>
Lindsay Creek	CWAL, SCR	Yes

<sup>1</sup>CWAL – Cold Water Aquatic Life, SCR – Secondary Contact Recreation

**Table 4. Water quality standards associated with beneficial uses.**

<b>Pollutant and IDAPA Citation</b>	<b>Beneficial Uses to which Standards Apply</b>	<b>Applicable Water Quality Standards</b>
Bacteria (58.01.02.251.02.a.b)	Secondary Contact Recreation	No greater than 126 <i>E. coli</i> organisms/100 mL as a 30 day geometric mean with a minimum of five samples AND no sample greater than 576 <i>E. coli</i> organisms/100 ml
Dissolved Oxygen (58.01.02.250.02.a)	Cold Water Aquatic Life	Dissolved Oxygen Concentrations exceeding six (6) mg/l at all times
Excess Nutrients (58.01.02.200.06)	General Surface Water Quality Criteria	Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses
Sediment (58.01.02.200.08)	General Surface Water Quality Criteria	Sediment shall not exceed quantities specified in general surface water quality criteria (IDAPA 58.01.02.250 or 252) or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses
Stream Temperature (58.01.02.250.02.b)	Cold Water Aquatic Life	Water temperatures of twenty-two (22) degrees C or less with a maximum daily average of no greater than nineteen (19) degrees C

### Designated Beneficial Uses

Idaho water quality standards require that surface waters of the state be protected for beneficial uses, wherever attainable (IDAPA 58.01.02.050.02).

The Clean Water Act defines designated uses as “those uses specified in water quality standards for each water body or segment, whether or not they are being attained.” Designated uses are simply uses officially recognized by the state and specified in the State’s water quality standards. Water quality must be sufficiently maintained to meet the most sensitive use.

Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protection of an existing higher quality use such as cold water aquatic life or salmonid spawning. Designated uses are specifically listed for water bodies in Idaho in tables in the Idaho water quality standards (see IDAPA 58.01.02.003.27 and .02.109-.02.160 in addition to citations for existing uses).

### Criteria to Support Beneficial Uses

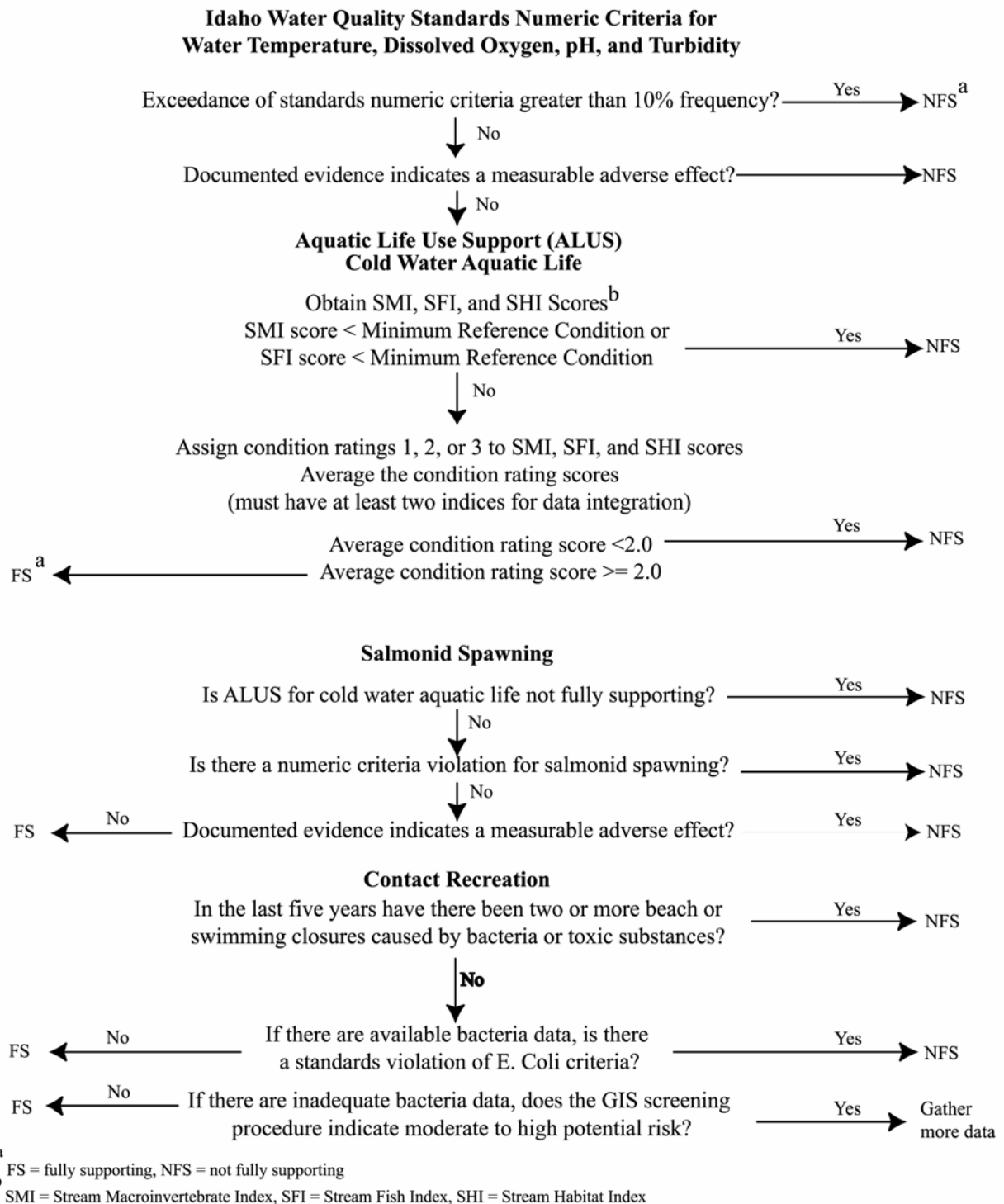
Beneficial uses are protected by a set of criteria, which include narrative criteria for pollutants such as sediment and nutrients, and numeric criteria for pollutants such as bacteria, dissolved oxygen, pH, ammonia, temperature, and turbidity (IDAPA 58.01.02.250) (Table 4).

Excess sediment is described by narrative criteria (IDAPA 58.01.02.200.08): “Sediment shall not exceed quantities specified in Sections 250 and 252 or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses. Determinations of impairment shall be based on water quality monitoring and surveillance and the information utilized as described in Subsection 350.”

Narrative criteria for excess nutrients are described in IDAPA 58.01.02.200.06, which states “Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses.”

Narrative criteria for floating, suspended, or submerged matter are described in IDAPA 58.01.02.200.05, which states “Surface waters of the state shall be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses. This matter does not include suspended sediment produced as a result of nonpoint source activities.”

DEQ’s procedure to determine whether a water body fully supports designated and existing beneficial uses is outlined in IDAPA 58.01.02.053. The procedure relies heavily upon biological parameters and is presented in detail in the Water Body Assessment Guidance (Grafe et al. 2002).



**Figure 4. Process for Determining Support Status of Beneficial Uses in Wadeable Streams: Water Body Assessment Guidance, Second Edition (Grafe et al. 2002)**

## 2.3 Pollutant Relationships to Beneficial Use Support Status

Most of the pollutants that impair beneficial uses in streams are naturally occurring stream characteristics that have been altered by humans. For example, streams naturally contain sediment and nutrients, but when anthropogenic sources cause these to reach unnatural levels, they are considered “pollutants” and can impair the beneficial uses of a stream.

### Temperature

Temperature is a water quality factor integral to the life cycle of fish and other aquatic species. Many factors, natural and anthropogenic, affect stream temperatures. Natural factors include altitude, aspect, climate, weather, riparian vegetation (shade), and channel morphology (width and depth). Human influenced factors include heated discharges (such as those from point sources), riparian alteration, channel alteration, and flow alteration.

High stream temperatures can be harmful to fish at all life stages, especially if they occur in combination with other problems such as low dissolved oxygen or poor food supply. Acceptable temperature ranges vary for different species of fish, with cold water species being the least tolerant of high water temperatures.

Temperature as a chronic stressor to adult fish can result in reduced body weight, reduced oxygen exchange, increased susceptibility to disease, and reduced reproductive capacity. Acutely high temperatures can result in death if they persist for an extended length of time. Juvenile fish are even more sensitive to temperature variations than adult fish, and can experience negative impacts at a lower threshold value than adults, manifesting in retarded growth rates.

High temperatures also affect embryonic development of fish before they even emerge from the substrate. Similar effects may occur to aquatic invertebrates, amphibians and mollusks, although less is known about them.

### Dissolved Oxygen

Oxygen is necessary for the survival of most aquatic organisms and is essential to stream purification. Dissolved oxygen (DO) is the concentration of free (not chemically combined) molecular oxygen (a gas) dissolved in water, usually expressed in milligrams per liter (mg/L), parts per million, or percent of saturation. While air contains approximately 20.9% oxygen gas by volume, the proportion of oxygen dissolved in water is about 35%, because nitrogen (the remainder) is less soluble in water.

Oxygen is considered to be moderately soluble in water. A complex set of physical conditions that include atmospheric and hydrostatic pressure, turbulence, temperature, and salinity affect solubility.

Dissolved oxygen levels of 6 mg/L and above are considered optimal for aquatic life. When DO levels fall below 6 mg/L, organisms are stressed. If levels fall below 3 mg/L for a

prolonged period, these organisms may die; oxygen levels that remain below 1-2 mg/L for a few hours can result in large fish kills. Dissolved oxygen levels below 1 mg/L are often referred to as hypoxic. Anoxic conditions refer to those situations where there is no measurable DO.

Juvenile aquatic organisms are particularly susceptible to the effects of low dissolved oxygen high metabolism and low mobility (they are unable to seek more oxygenated water). In addition, oxygen is necessary to help decompose organic matter in the water and bottom sediments. Dissolved oxygen reflects the health or the balance of the aquatic ecosystem.

Oxygen is produced during photosynthesis and consumed during plant and animal respiration and decomposition. Oxygen enters water from photosynthesis and from the atmosphere. Where water is more turbulent (e.g., riffles, cascades), the oxygen exchange is greater due to the greater surface area of water coming into contact with air. The process of oxygen entering the water is called aeration.

Water bodies with significant aquatic plant communities can have significant dissolved oxygen fluctuations throughout the day. An oxygen sag will typically occur once photosynthesis stops at night and respiration/decomposition processes deplete DO concentrations in the water. Oxygen will start to increase again as photosynthesis resumes with the advent of daylight.

Temperature, flow, nutrient loading, and channel alteration all impact the amount of DO in the water. Colder waters hold more DO than warmer waters. As flows decrease, the amount of aeration typically decreases and the in-stream temperature increases, resulting in decreased DO. Channels that have been altered to increase the effectiveness of conveying water often have fewer riffles and less aeration. Thus, these systems may show depressed levels of DO in comparison to levels before the alteration. Nutrient enriched waters have a higher biochemical oxygen demand due to the amount of oxygen required for organic matter decomposition and other chemical reactions. This oxygen demand results in lower in-stream DO levels.

### Sediment

Both suspended (floating in the water column) and bedload (moves along the stream bottom) sediment can have negative effects on aquatic life communities. Many fish species can tolerate elevated suspended sediment levels for short periods of time, such as during natural spring runoff, but longer durations of exposure are detrimental. Elevated suspended sediment levels can interfere with feeding behavior (difficulty finding food due to visual impairment), damage gills, reduce growth rates, and in extreme cases eventually lead to death.

Newcombe and Jensen (1996) reported the effects of suspended sediment on fish, summarizing 80 published reports on streams and estuaries. For rainbow trout, physiological stress, which includes reduced feeding rate, is evident at suspended sediment concentrations of 50 to 100 mg/L when those concentrations are maintained for 14 to 60 days. Similar effects are observed for other species, although the data sets are less reliable. Adverse effects

on habitat, especially spawning and rearing habitat presumably from sediment deposition, were noted at similar concentrations of suspended sediment. Organic suspended materials can also settle to the bottom and, due to their high carbon content, lead to low inter gravel dissolved oxygen through decomposition.

In addition to these direct effects on the habitat and spawning success of fish, detrimental changes to food sources may also occur. Aquatic insects, which serve as a primary food source for fish, are affected by excess sedimentation. Increased sedimentation leads to a macroinvertebrate community that is adapted to burrowing, thereby making the macroinvertebrates less available to fish. Community structure, specifically diversity, of the aquatic macroinvertebrate community is diminished due to the reduction of coarse substrate habitat.

Settleable solids are typically defined as the volume in milliliters (ml) or as the weight in milligrams (mg) of material that settles out of a liter of water in one hour (Franson et al. 1998). Settleable solids may consist of large silt, sand, and organic matter. Total suspended solids are defined as the material collected by filtration through a 0.45  $\mu\text{m}$  (micrometer) filter (Standard Methods 1975, 1995).

Settleable solids and total suspended solids both contain nutrients that are essential for aquatic plant growth. Settleable solids are not as nutrient rich as the smaller total suspended solids, but they do affect river depth and substrate nutrient availability for macrophytes. In low flow situations, settleable solids can accumulate on a stream bottom, thus decreasing water depth. This increases the area of substrate that is exposed to light, facilitating additional macrophyte growth.

### Bacteria

*Escherichia coli* or *E. coli* is a species of fecal coliform bacteria used by the state of Idaho as the indicator for the presence of pathogenic microorganisms. Pathogens are a small subset of microorganisms (e.g., certain bacteria, viruses, and protozoa), which, if taken into the body through contaminated water or food, can cause sickness or even death. Some pathogens are also able to cause illness by entering the body through the skin or mucous membranes.

Direct measurement of pathogen levels in surface water is difficult because pathogens usually occur in very low numbers and analysis methods are unreliable and expensive. Bacteria are often associated with pathogens and are more easily measured so they are assessed as an indicator of the presence of pathogens.

Coliform bacteria are organisms found in feces of warm-blooded animals such as humans, pets, livestock, and wildlife. The human health effects from coliform bacteria include nausea, diarrhea, acute respiratory illness, meningitis, ulceration of the intestines, and even death. Coliform bacteria do not have a known effect on aquatic life.

Coliform bacteria from both point and nonpoint sources impact water bodies, although point sources are typically regulated by their discharge permit and offer some level of bacteria-

reducing treatment prior to discharge. Nonpoint sources of bacteria are diffuse and difficult to characterize. *E. coli* is often measured in colony forming units (cfu) per 100 ml.

### Nutrients

Nutrients are a natural component of the aquatic ecosystem. The ecosystem cycle can be disrupted by excess nutrients. Excess nutrients can cause an eutrophic or unbalanced enriched system.

The first step in determining if a water body has excess nutrients is to define which of the critical nutrients is limiting. A limiting nutrient is one that normally is in short supply relative to biological needs. The relative quantity affects the rate of production of aquatic biomass. Either phosphorus or nitrogen may be the limiting factor for algal growth, although phosphorous is most commonly the limiting nutrient in Idaho waters. Ecologically speaking, a resource is considered limiting if the addition of that resource increases growth.

Total phosphorus is the measurement of all forms of phosphorus in a water sample, including all inorganic and organic particulate and soluble forms. In freshwater systems, typically greater than 90% of the total phosphorus present occurs in organic forms as cellular constituents in the biota or adsorbed to particulate materials (Wetzel 1983). The remainder of phosphorus is mainly soluble orthophosphate, a more biologically available form of phosphorus than total phosphorus, that consequently leads to a more rapid growth of algae. In impaired systems, a larger percentage of the total phosphorus fraction is comprised of orthophosphate. The relative amount of each form measured can provide information on the potential for algal growth within the system.

Nitrogen may be a limiting factor at certain times if there is substantial depletion of nitrogen in sediments due to uptake by rooted macrophyte beds. In systems dominated by blue-green algae, nitrogen is not a limiting nutrient due to the algal ability to fix nitrogen at the water/air interface.

Total nitrogen to total phosphorus ratios greater than seven are indicative of a phosphorus-limited system while those ratios less than seven are indicative of a nitrogen-limited system. Only biologically available forms of the nutrients are used in the ratios because these are the forms that are used by the immediate aquatic community.

Nutrients primarily cycle between the water column and sediment through nutrient spiraling. Aquatic plants rapidly assimilate dissolved nutrients, particularly orthophosphate. If sufficient nutrients are available in the sediments or the water column, aquatic plants will store an abundance of such nutrients in excess of the plants' actual needs. When a plant dies, the tissue decays in the water column and the nutrients stored within the plant biomass are either restored to the water column or the detritus becomes incorporated into the river sediment. As a result of this process, nutrients (including orthophosphate) that are initially released into the water column in a dissolved form will eventually become incorporated into the river bottom sediment. Once these nutrients are incorporated into the river sediment, they are available once again for uptake by yet another life cycle of rooted aquatic macrophytes

and other aquatic plants. This cycle is known as nutrient spiraling. Nutrient spiraling results in the availability of nutrients for later plant growth in higher concentrations downstream.

### Sediment – Nutrient Relationship

The linkage between sediment and sediment-bound nutrients is important when dealing with nutrient enrichment problems in aquatic systems. Phosphorus is typically bound to particulate matter in aquatic systems and, thus, sediment can be a major source of phosphorus to rooted macrophytes and the water column.

While most aquatic plants are able to absorb nutrients over the entire plant surface due to a thin cuticle (Denny 1980), bottom sediments serve as the primary nutrient source for most sub-stratum attached macrophytes. The USDA (1999) determined that other than harvesting and chemical treatment, the best and most efficient method of controlling growth is by reducing surface erosion and sedimentation.

Sediment acts as a nutrient sink under aerobic conditions. When conditions become anoxic the sediments will release phosphorous into the water column. Nitrogen can also be released, but the mechanism by which it happens is different. The exchange of nitrogen between sediment and the water column is, for the most part, a microbial process controlled by the amount of oxygen in the sediment. When conditions become anaerobic, the oxygenation of ammonia (nitrification) ceases and an abundance of ammonia is produced. This results in a reduction of nitrogen oxides (NO<sub>x</sub>) being lost to the atmosphere.

Sediments can play an integral role in reducing the frequency and duration of phytoplankton blooms in standing waters and large rivers. In many cases there is an immediate response in phytoplankton biomass when external sources are reduced. In other cases, the response time is slower, often taking years. Nonetheless, the relationship is important and must be addressed in waters where phytoplankton is in excess.

### Floating, Suspended, or Submerged Matter (Nuisance Algae)

Algae are an important part of the aquatic food chain. However, when elevated levels of algae impact beneficial uses, the algae are considered a nuisance aquatic growth. The excess growth of phytoplankton, periphyton, and/or macrophytes can adversely affect both aquatic life and recreational water uses.

Algal blooms occur where adequate nutrients (nitrogen and/or phosphorus) are available to support growth. In addition to nutrient availability, flow rates, velocities, water temperatures, and penetration of sunlight in the water column all affect algae (and macrophyte) growth. Low velocity conditions allow algal concentrations to increase because physical removal by scouring and abrasion does not readily occur. Increases in temperature and sunlight penetration also result in increased algal growth. When the aforementioned conditions are appropriate and nutrient concentrations exceed the quantities needed to support normal algal growth, excessive blooms may develop.

Commonly, algae blooms appear as extensive layers or algal mats on the surface of the water. When present at excessive concentrations in the water column, blue-green algae often produce toxins that can result in skin irritation to swimmers and illness or even death in organisms ingesting the water. The toxic effect of blue-green algae is worse when an abundance of organisms die and accumulate in a central area.

Algal blooms also often create objectionable odors and coloration in water used for domestic drinking water and can produce intense coloration of both the water and shorelines as cells accumulate along the banks. In extreme cases, algal blooms can also result in impairment of agricultural water supplies due to toxicity. Water bodies with high nutrient concentrations that could potentially lead to a high level of algal growth are said to be eutrophic. The extent of the effect is dependent on both the type(s) of algae present and the size, extent, and timing of the bloom.

When algae die in low flow velocity areas, they sink slowly through the water column, eventually collecting on the bottom sediments. The biochemical processes that occur as the algae decompose remove oxygen from the surrounding water. Because most of the decomposition occurs within the lower levels of the water column, a large algal bloom can substantially deplete dissolved oxygen concentrations near the bottom.

Low dissolved oxygen in these areas can lead to decreased fish habitat as fish will not frequent areas with low dissolved oxygen. Both living and dead (decomposing) algae can also affect the pH of the water due to the release of various acid and base compounds during respiration and photosynthesis. Additionally, low dissolved oxygen levels caused by decomposing organic matter can lead to changes in water chemistry and a release of absorbed phosphorus to the water column at the water/sediment interface.

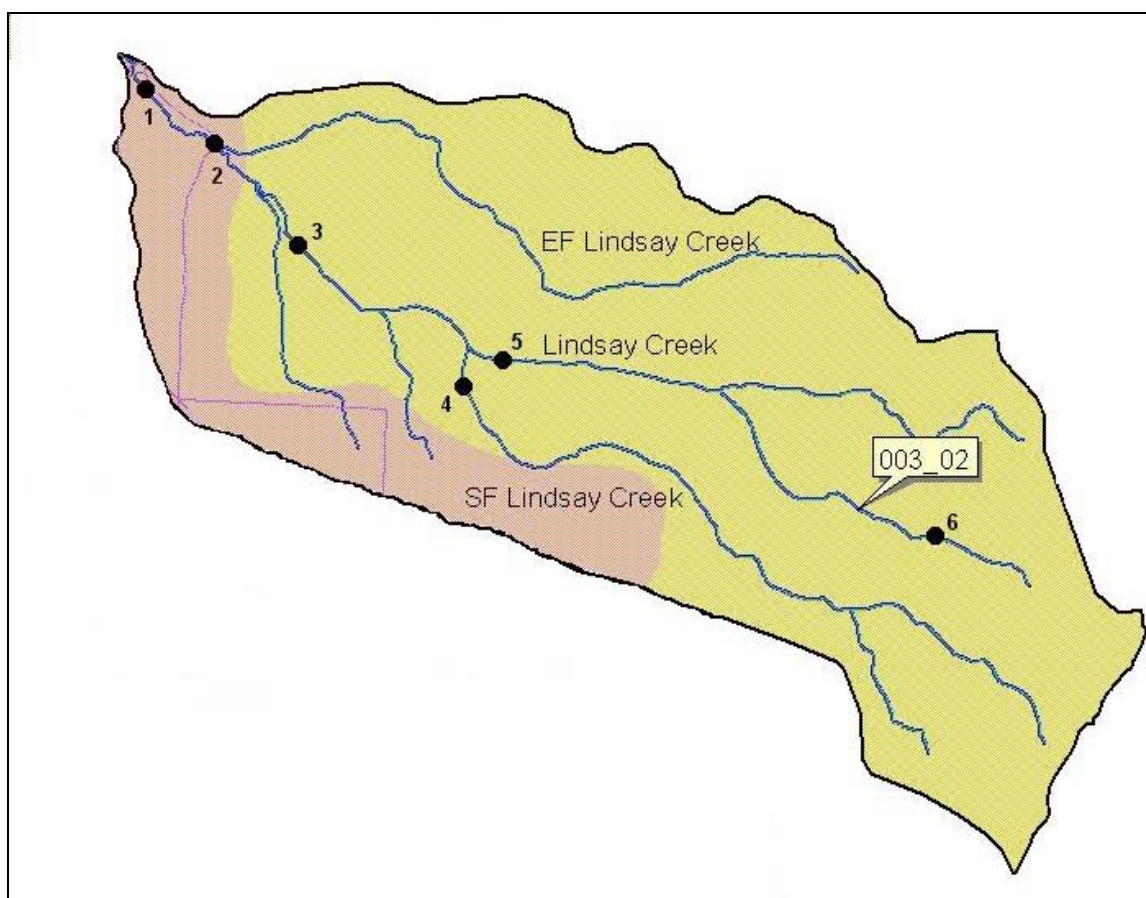
Excess nutrient loading can be a water quality problem due to the direct relationship of high total phosphorus concentrations on excess algal growth within the water column, combined with the direct effect of the algal life cycle on dissolved oxygen and pH within aquatic systems. Therefore, the reduction of total phosphorus to the system can act as a mechanism for water quality improvements, particularly in surface-water systems dominated by blue-green algae, which can acquire nitrogen directly from the atmosphere and the water column. Phosphorus management within these systems can potentially result in improvement in nutrients, nuisance algae, dissolved oxygen, and pH.

## **2.4 Summary and Analysis of Existing Water Quality Data**

This section summarizes and analyzes the available biological, chemical, and physical data for the Lindsay Creek watershed as it relates to determining beneficial use support status and compliance with Idaho water quality standards. Data used for the development of the total maximum daily loads was provided by the Idaho Association of Soil Conservation Districts (Appendix B). Additional data was collected by DEQ personnel and is described in the following subsections.

A water quality sampling project was conducted by the Idaho Association of Soil Conservation Districts personnel from February 27, 2001 to February 25, 2002. Specific parameters that were sampled for included total phosphorus, ortho-phosphate, nitrite+nitrate-nitrogen, *E. coli* and total coliform bacteria, total suspended solids, turbidity, specific conductance, pH, % dissolved oxygen saturation, temperature, flow and dissolved oxygen. Instantaneous sampling occurred approximately every two weeks at six sites throughout the watershed (IASCD 2002). The established sites are shown in Figure 5.

Figure 5 displays the corrected delineation of assessment unit (AU) 17060306CL003\_02. In order to characterize comparable segments for assessment purposes, the 17060306CL003\_02 AU was further delineated based on land use considerations. The 17060306CL003\_02 AU begins at the designated wetland located directly below the Mann's Reservoir dam, which is considered the headwaters of Lindsay Creek. Mann's Reservoir is AU 17060306CL003\_02a.



**Figure 5. IASCD Monitoring Sites**

### Flow Characteristics

Instantaneous flow measurements collected from the 2001-2002 monitoring season indicate Lindsay Creek is perennial from the headwaters near Mann's Reservoir to its confluence with

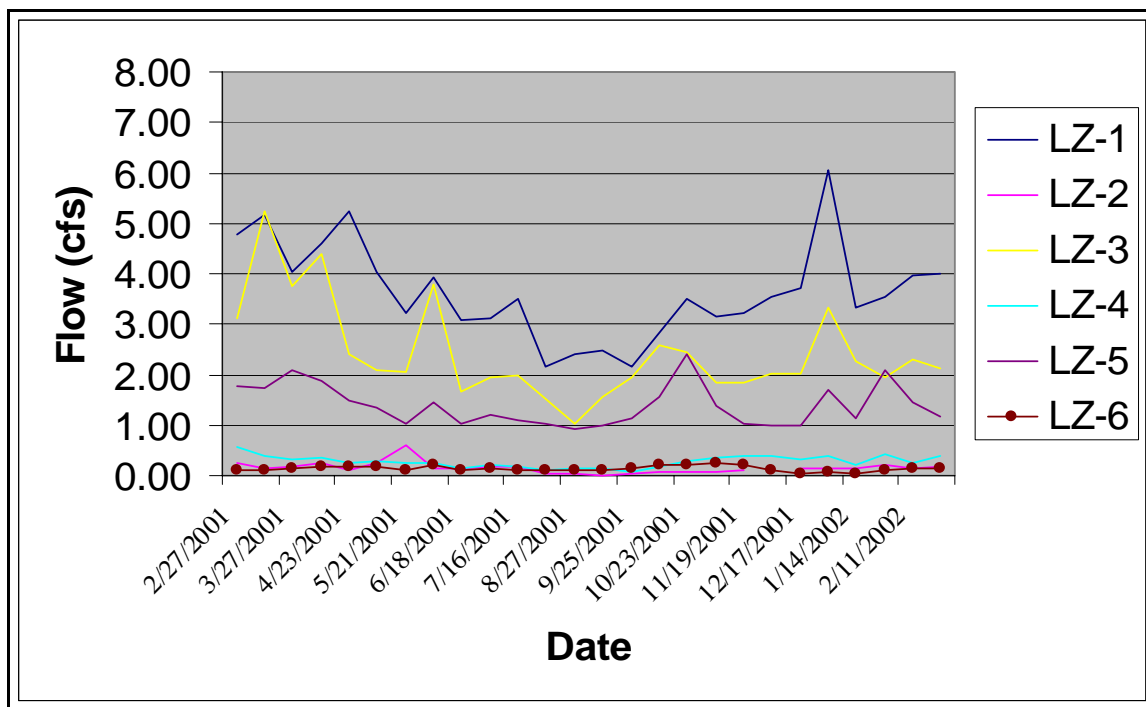
the Clearwater River (Table 5). Instantaneous flow data collected on the East Fork Lindsay Creek (LZ-2) and South Fork Lindsay Creek (LZ-4) confirms they are perennial as well.

Average annual flow was the highest at site LZ-1, which can be explained by the influence of intermittent creeks entering from the southwestern portion of the watershed, the perennial LZ-2 tributary, and springs. Average annual flows at sites LZ-3 and LZ-5 were 2.43 cfs and 1.39 cfs, respectively. Flows decreased between mid-June and early-October. Sites LZ-2, LZ-4, and LZ-6 all exhibited annual average flows of less than one (1) cfs. Table 5 shows the average, maximum, and minimum flows measured at the six sampling sites. Figure 6 illustrates the flow characteristics of the watershed for the period February 27, 2001 to February 25, 2002.

**Table 5. Monitored flows in the Lindsay Creek watershed (February 27, 2001 through February 25, 2002).**

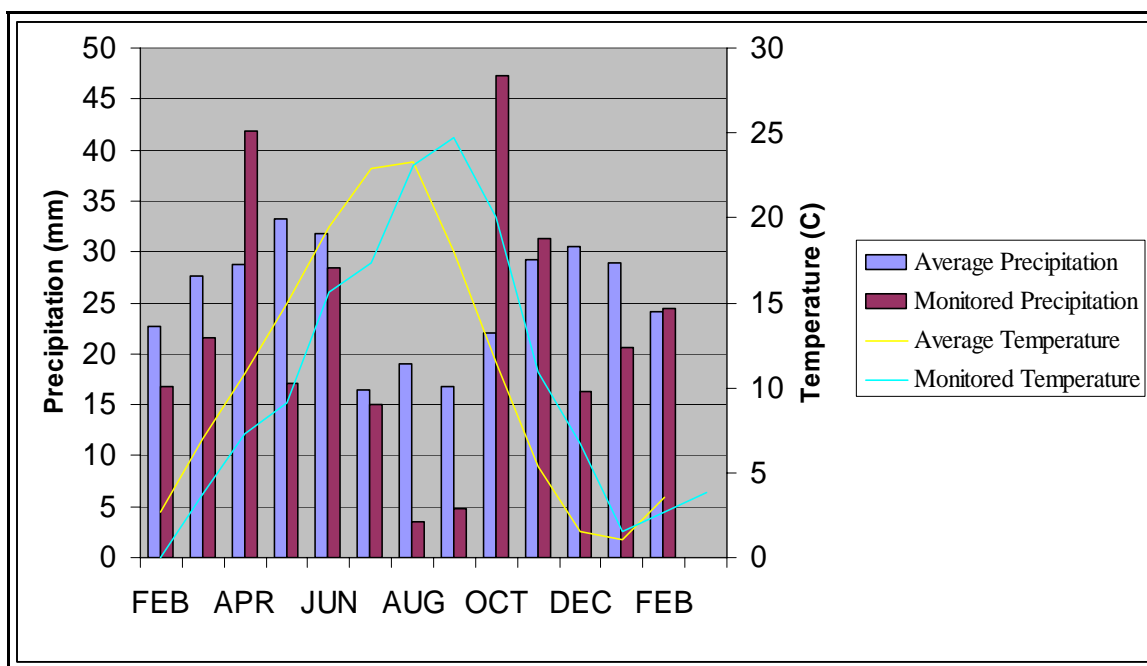
Flow (cfs) <sup>a</sup>	LZ-1	LZ-2	LZ-3	LZ-4	LZ-5	LZ-6
Mean	3.65	0.15	2.43	0.28	1.39	0.13
Maximum	6.05	0.59	5.25	0.55	2.40	0.24
Minimum	2.15	0.02	1.02	0.09	0.93	0.03

<sup>a</sup> cubic feet per second



**Figure 6. Stream Flow in the Lindsay Creek Watershed (February 27, 2001 Through February 25, 2002)**

During the period monitored, the Lewiston area received less than the average monthly precipitation from February 2001 through January 2002, a negative 3.2 mm departure from normal. Ambient air temperatures were slightly higher than normal (+ 0.35 °C). Significantly less precipitation (-45.2 mm) fell during May, July, August and September 2001 from the average, and ambient temperatures increased slightly from the normal during the same months (Figure 7).



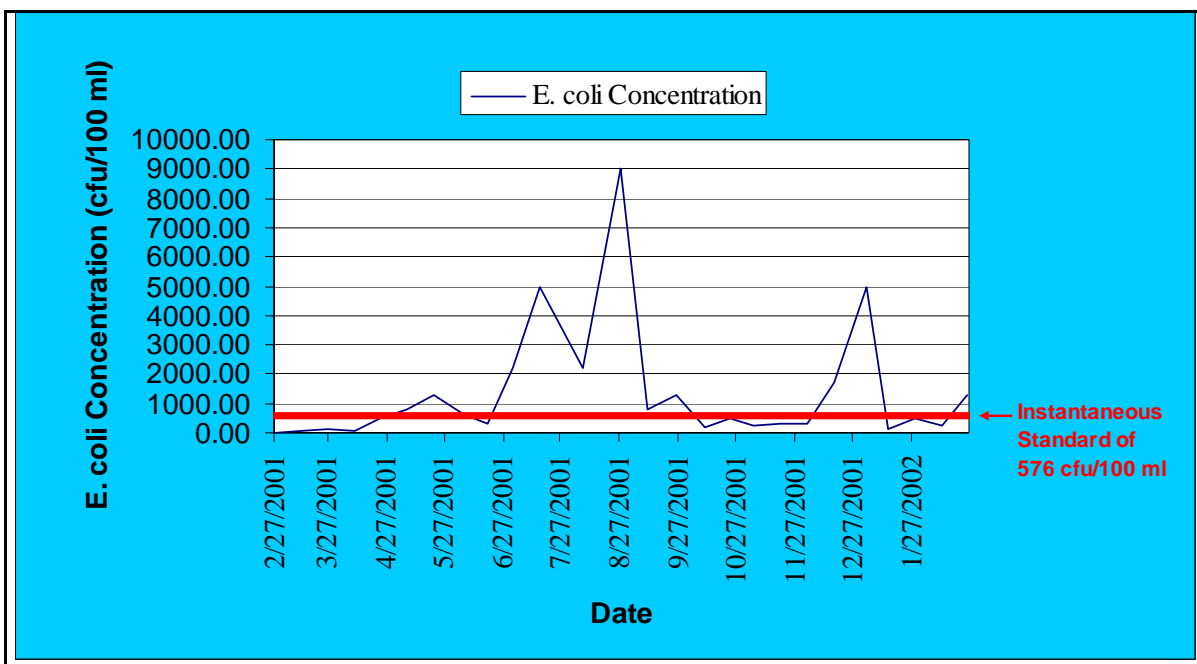
**Figure 7. Measured Monthly Temperature and Precipitation vs. 30 Year Monthly Averages for Temperature and Precipitation**

#### Water Column Data

##### Pathogens

The state of Idaho criteria for *E. coli* is that bacteria are not to exceed 126 colony forming units per 100 milliliters of solution (cfu/100 ml) as a 30-day geometric mean or 406 cfu/100 ml as an instantaneous sample for primary contact recreation. Water bodies designated for secondary contact recreation, such as Lindsay Creek, must not exceed the 30-day geometric mean criterion, and cannot exceed 576 cfu/100 ml as an instantaneous sample (IDAPA 58.01.02.251.01 & 02).

During the 2001-2002 monitoring season, 64 samples, or 41% of the total samples measured for *E. coli* bacteria, exceeded the 576 cfu/100 ml criterion: twelve at site LZ-1, twenty-three at site LZ-2, fourteen at site LZ-3, three at site LZ-4, four at site LZ-5, and eight at site LZ-6 (Appendix B). Figure 8 displays *E. coli* bacteria concentrations at site LZ-1 in relation to Idaho's instantaneous criterion.



**Figure 8. *E. coli* Bacteria Concentrations at the LZ-1 Monitoring Site (February 27, 2001 through February 25, 2002)**

Forty-six percent of the *E. coli* bacteria samples collected at site LZ-1 between May 2001 through September 2001 and December 2001 through February 2002 exceeded Idaho's criterion. LZ-1 exceeded Idaho's geometric mean standard during the month of April 2005 (Table 6). Concentrations at site LZ-2 exceeded Idaho's instantaneous criterion at least once per month from March 13, 2001 through February 25, 2002, or approximately 85% of the period samples were collected and measured.

Bacteria samples analyzed from site LZ-3 show Idaho's instantaneous criterion was exceeded from April 23, 2001 through January 3, 2002. Site LZ-4 exceeded the instantaneous criterion on three continuous sampling dates from June 18, 2001 through July 16, 2001, and was below the instantaneous criterion for the remainder of the monitoring season. *E. coli* concentrations at site LZ-5 were above the instantaneous criterion in May, June, July, and December and site LZ-6 exceeded the criterion from July through October 2001 and in January of 2002 (Appendix B).

Additional monitoring was conducted in April 2005 at site LZ-1 to assess compliance with Idaho's 126 cfu/100 ml criterion. Table 6 shows the concentrations from the April sampling, the computed geometric mean based on resultant values, and the concentration allowed by Idaho water quality standards.

**Table 6. *E. coli* bacteria concentrations at site LZ-1 (April 2005).**

Date	Concentration (cfu/100 ml) <sup>1</sup>
4/4/2005	397
4/7/2005	183
4/11/2005	253
4/15/2005	338
4/20/2005	468
4/25/2005	624
4/29/2005	486
April geometric mean	366
Allowable concentration	126

<sup>1</sup> colony forming units per 100 milliliters of solution

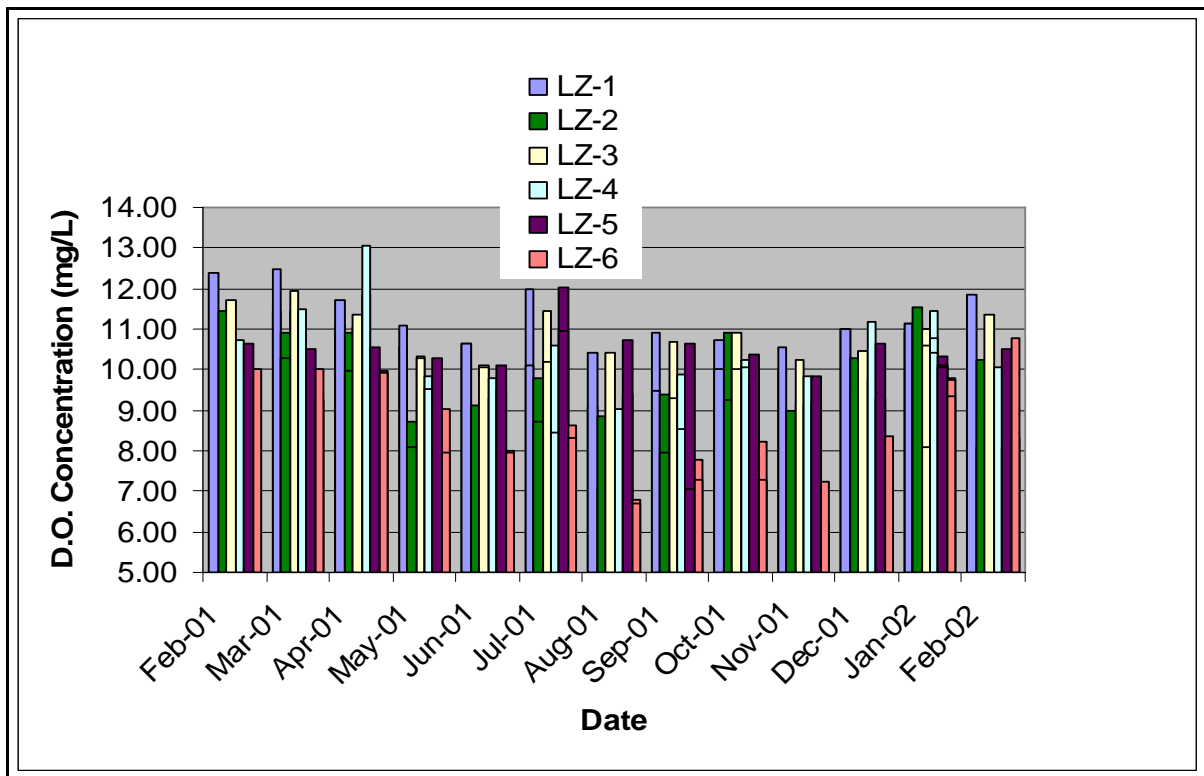
As shown, samples collected and analyzed for *E. coli* bacteria at site LZ-1 exceeded Idaho's water quality standard (geometric mean criterion). Based on these measured samples, a 66% (240 cfu/100 ml reduction) reduction in *E. coli* bacteria concentrations is needed to comply with Idaho water quality standards.

### Dissolved Oxygen

Waters designated for cold water aquatic life must sustain dissolved oxygen concentrations of 6.0 milligrams per liter (mg/L) or greater at all times (IDAPA 58.01.02.250.02.a).

Displayed in Figure 9 are the instantaneous concentrations at the six monitoring sites by month. Instantaneous dissolved oxygen concentrations ranged from 6.23 mg/L to 12.49 mg/L throughout the watershed (Appendix B), with an annual instantaneous average of 10.85 mg/L at site LZ-1 (Table 7).

During the evening, when aquatic vegetation is producing less oxygen to the surrounding water column, many organisms continue to decompose plant material and subsequently utilize available dissolved oxygen. This can cause a decline in oxygen concentrations and can be measured in the water column and correlated to cyclic plant growth and decay where problems exist. To document whether declines in dissolved oxygen exist diurnally, measurements were taken at site LZ-1 from August 14, 2005 through August 21, 2005. Resultant dissolved oxygen values recorded during the study ranged from 8.85 mg/L to 10.72 mg/L with an average concentration of 9.6 mg/L (Appendix C).



**Figure 9. Instantaneous Dissolved Oxygen Concentrations in the Lindsay Creek Watershed (February 27, 2001 to February 25, 2002)**

**Table 7. Instantaneous dissolved oxygen concentrations in the Lindsay Creek watershed (February 27, 2001 to February 25, 2002).**

mg/L	LZ-1	LZ-2	LZ-3	LZ-4	LZ-5	LZ-6
<b>Mean</b>	10.85	9.54	10.37	10.10	10.00	8.47
<b>Maximum</b>	12.49	11.55	11.94	13.07	12.02	10.79
<b>Minimum</b>	9.06	7.08	8.07	7.61	7.07	6.23
<b>Range</b>	3.43	4.47	3.87	5.46	4.95	4.56

### Stream Temperature

Lindsay Creek has been designated by the state of Idaho as having a cold water aquatic life beneficial use. Water bodies in the state of Idaho designated for a cold water aquatic life beneficial use are not to exceed water temperatures of 22 °C, and a daily average of 19 °C (IDAPA 58.01.02.250.02.b).

Table 8 shows instantaneous temperatures in the Lindsay Creek watershed ranged from 1.0 °C at LZ-2 to 19.0 °C at site LZ-6, with an annual average of 10.85 °C at site LZ-1. Diurnal temperature data was collected from August 14, 2005 through August 21, 2005 at site LZ-1 to assess stream temperatures when ambient air temperatures are assumed to be the highest. The maximum recorded stream temperature was 18.28 °C on August 21, 2005. The daily average stream temperature for August 21, 2005 was 16.1 °C and the ambient air temperature reached 104 °F. The minimum temperature recorded was 12.95 °C and the weekly average was 15.5 °C. Raw data from the week-long temperature study is contained in Appendix C.

**Table 8. Instantaneous stream temperatures in the Lindsay Creek watershed (February 27, 2001 through February 25, 2002).**

°C	LZ-1	LZ-2	LZ-3	LZ-4	LZ-5	LZ-6
<b>Mean</b>	10.5	10.3	11.0	10.7	11.5	10.6
<b>Maximum</b>	15.8	18.2	17.6	16.5	15.7	19.0
<b>Minimum</b>	5.1	1.0	5.2	5.2	6.6	2.6
<b>Range</b>	10.7	17.2	12.4	11.3	9.1	16.4

### Nutrients

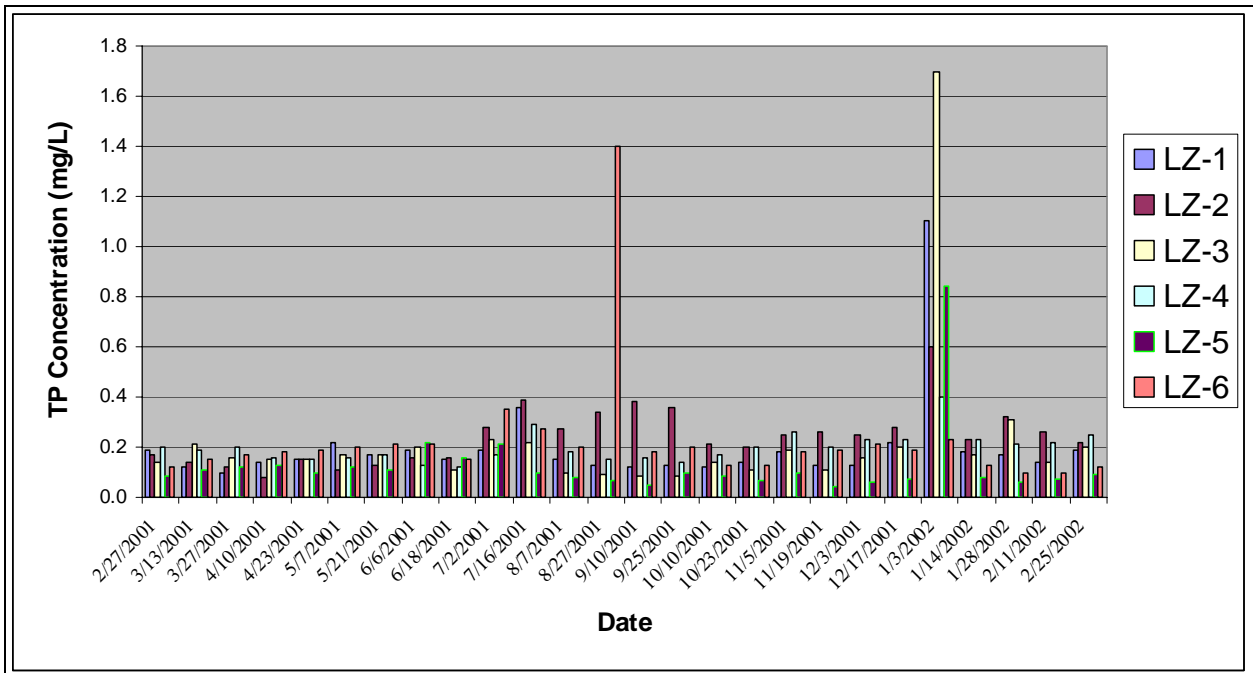
Idaho's narrative standard for nutrients states "surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses" (IDAPA 58.01.02.200.06). Primary/secondary contact recreation can also be impacted by visible slime and algae growth caused by excessive nutrients when temperature and sunlight are not limiting.

In order to prevent nuisance algae growth and dissolved oxygen problems, the Environmental Protection Agency developed a national guideline for streams of 0.1 mg/L total phosphorus (USEPA 1986). More recently the Environmental Protection Agency developed a nutrient criterion for total phosphorus of 0.030 mg/L specific to Columbia Plateau subcoregion streams (USEPA 2000). These criteria provide the Environmental Protection Agency's most recent recommendations for use in establishing their water quality standards. The Environmental Protection Agency further recommends that, wherever possible, states develop nutrient criteria that fully reflect localized conditions and protect specific designated uses.

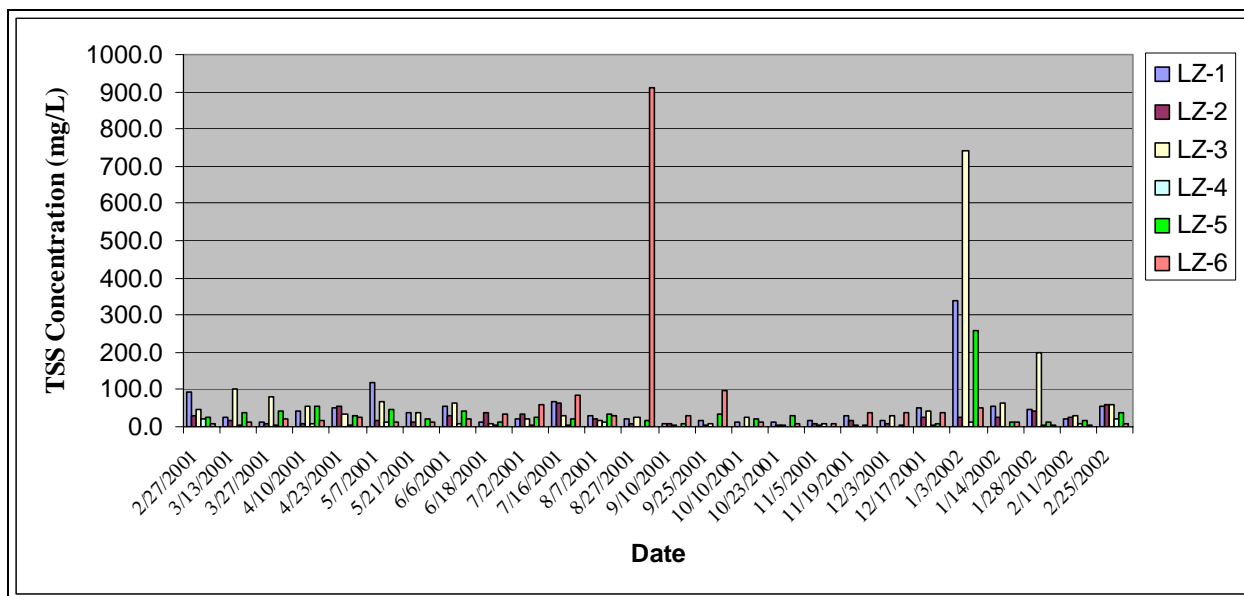
Total phosphorus concentrations ranged from 0.045 mg/L at site LZ-5 to 1.7 mg/L at site LZ-3. The collective annual average was 0.203 mg/L. Figure 10 displays the total phosphorus concentrations for each site monitored in Lindsay Creek. Figure 11 shows the total suspended solid values recorded at each site. On January 3, 2002, total phosphorus values spiked significantly in comparison to other sampling dates at the three main stem sites: LZ-1, LZ-3,

and LZ-5. The increase in total phosphorus and total suspended solids was the result of heavy tilling of a field located upstream from site LZ-5 prior to 0.50 inches of precipitation that fell between January 2 and January 3 of 2002 (IASCD 2002).

A concentration of 1.4 mg/L total phosphorus was observed on August 27, 2001 at site LZ-6. This was four times greater than the second highest value at the site. The 1.4 mg/L spike is most likely a result of livestock activity as large amounts of organic matter was also observed in the stream at this time (IASCD 2002).



**Figure 10. Total Phosphorous Concentrations for the Lindsay Creek Watershed (February 27, 2001 to February 25, 2002)**



**Figure 11. Total Suspended Solid Concentrations for the Lindsay Creek Watershed (February 27, 2001 to February 25, 2002)**

Ortho-phosphorous concentrations ranged from 0.026 mg/L at site LZ-5 to 0.440 mg/L at site LZ-2. The collective annual average was 0.117 mg/L. Mean phosphate concentrations were the highest at site LZ-2, ranging from 0.049 mg/L to 0.440 mg/L, while site LZ-6 had the lowest range (Table 9).

**Table 9. Ortho-phosphorous data summary for the Lindsay Creek watershed (February 27, 2001 to February 25, 2002).**

mg/L	LZ-1	LZ-2	LZ-3	LZ-4	LZ-5	LZ-6
Mean	0.112	0.175	0.102	0.162	0.059	0.090
Maximum	0.290	0.440	0.260	0.360	0.230	0.130
Minimum	0.067	0.049	0.060	0.080	0.026	0.061
Range	0.223	0.391	0.20	0.28	0.204	0.069

Total nitrogen is a measure of the organic and inorganic nitrogen present in the water sample. Naturally occurring organic nitrogen compounds are largely tied up in organic particles of partial decomposition products of once living organisms. Organic nitrogen must be released or mineralized to inorganic nitrogen, ammonia, and nitrate before becoming available to support plant growth.

Total inorganic nitrogen is nitrate and nitrite plus ammonia. Total inorganic nitrogen is the form of nitrogen available for plant uptake. Nitrite is rapidly oxidized to nitrate with oxygen,

so it is rare to find nitrite in surface water. Ammonia also oxidizes, first to nitrite and then to nitrate, so most of the total inorganic nitrogen ends up as nitrate in surface water. The available nitrogen data in Lindsay Creek are expressed as nitrite+nitrate as nitrogen.

Measured nitrite+nitrate-N concentrations in samples collected from Lindsay Creek ranged from below the analytical detection limit at site LZ-6 to 11.0 mg/L at site LZ-4. The collective average was 4.85 mg/L. The largest range in concentrations was seen at LZ-4, while the lowest range was near the headwaters at site LZ-6. The minimum nitrite+nitrate-N concentrations shown in Table 10 were recorded on June 18, 2001 at all six sites, as flows decreased from the prior June 6, 2001 sampling event at every site but LZ-6, which sustained the same flow of 0.14 cfs.

**Table 10. Nitrite+nitrate-N data summary for the Lindsay Creek watershed (February 27, 2001 to February 25, 2002).**

mg/L	LZ-1	LZ-2	LZ-3	LZ-4	LZ-5	LZ-6
<b>Mean</b>	5.96	5.62	5.07	8.45	3.69	0.33
<b>Maximum</b>	7.40	8.20	6.80	11.00	5.30	0.49
<b>Minimum</b>	1.30	0.84	1.00	2.20	0.80	BDL
<b>Range</b>	6.10	7.36	5.80	8.80	4.50	0.45

BDL – below detection limit

#### Suspended Solids (Sediment)

The available water column data are reported in terms of total suspended solids. Low total suspended solids typically mean the total suspended sediment is low as well. Table 11 shows the average, maximum, and minimum total suspended solids concentrations. Figure 12 shows the total suspended solids data on a monthly basis at the six monitoring stations.

**Table 11. TSS concentrations in the Lindsay Creek watershed (February 27, 2001 to February 25, 2002).**

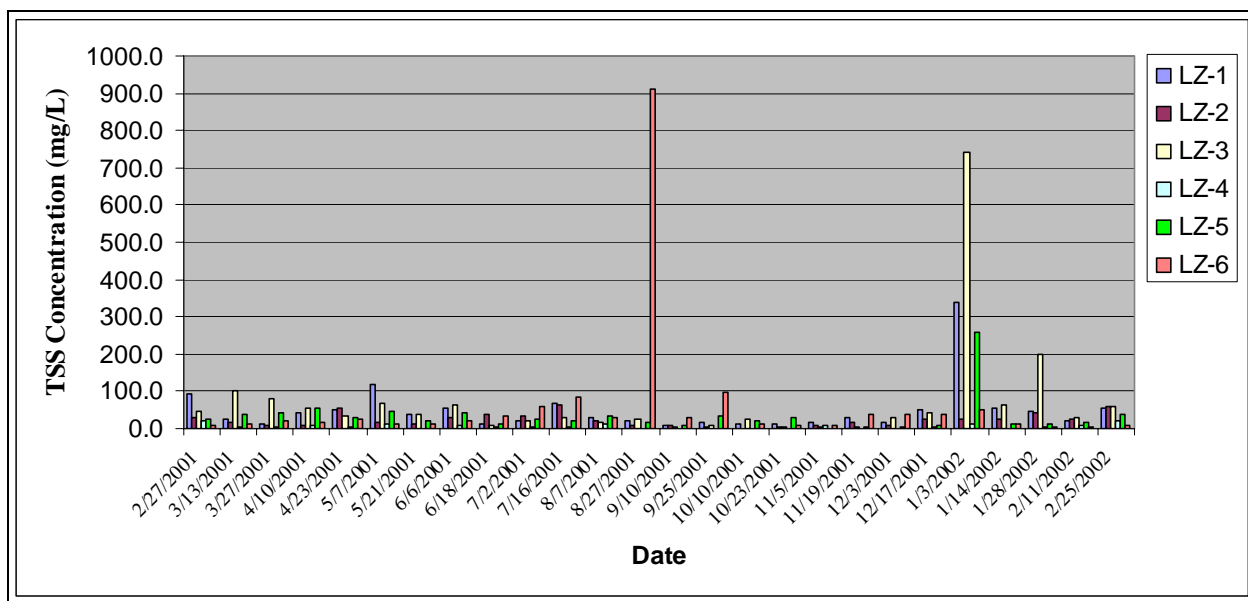
mg/L	LZ-1	LZ-2	LZ-3	LZ-4	LZ-5	LZ-6
<b>Mean</b>	48.8	23.7	69.5	9.4	35.1	61.2
<b>Maximum</b>	340.0	63.0	740.0	22.0	260.0	910.0
<b>Minimum</b>	9.0	4.0	4.0	4.0	4.0	4.0

Total suspended solids values ranged from 910 mg/L near the headwaters to 4.0 mg/L at five of the six monitoring sites (Appendix B). Samples collected during the 2001-2002 monitoring season were below the detection limit of 4.0 mg/L on the LZ-4 tributary and at

sites LZ-2 and LZ-5. As discussed above, elevated total suspended solids concentrations were observed on August 27, 2001 at site LZ-6 and at the main stem sites LZ-1, LZ-3, and LZ-5 on January 3, 2002. The increase in total suspended solids was the result of heavy tilling of a field located upstream from site LZ-5 prior to 0.50 inches of precipitation that fell between January 2 and January 3 of 2002 (IASCD 2002).

IDAPA 58.01.02.250.02.e. states that turbidity values shall not exceed background turbidity by more than fifty NTU instantaneously or more than twenty-five NTU for more than ten consecutive days. Continuous turbidity data for Lindsay Creek does not exist; turbidity values analyzed in this document are from instantaneous recordings.

Sites LZ-1, LZ-2, LZ-3, and LZ-5 were above 50 NTU on the same occasion (January 3, 2002) due to heavy tilling of a field upstream of site LZ-5 prior to 0.50 inches of precipitation (IASCD 2002). Site LZ-6 was above 50 NTU on August 27, 2001. Site LZ-3 was above 50 NTU on January 3, 2002 and January 28, 2002. Measured turbidity values at site LZ-4 did not exceed 22.0 NTU (Appendix B).



**Figure 12. Total Suspended Solid Concentrations for the Lindsay Creek Watershed (February 27, 2001 to February 25, 2002)**

As listed in Table 4, the Idaho water quality standard for sediment is narrative, meaning there is not a numeric value against which total suspended solids in the Lindsay Creek watershed can be compared to determine compliance with water quality standards; instead, the standards require consideration of whether or not the beneficial use is being supported.

### Beneficial Use Support Status

DEQ investigated the Lindsay Creek cold water aquatic life designated beneficial uses in accordance with Idaho Code 39-3607. Beneficial Use Reconnaissance Program data was collected from one site in the Lindsay Creek watershed in 1995. The site was located on a second order segment of Lindsay Creek, on the Wagner Farms property (1995SLEWB002). The result of the Stream Macroinvertebrate Index for this site is rated as not meeting minimum thresholds for the lowest percentile category. The Stream Macroinvertebrate Index score of '0' is below the minimum of reference conditions, which indicates impairment. The survey was not conducted in the third order segment of Lindsay Creek.

In April 2005, three macroinvertebrate samples were collected for more current macroinvertebrate data on the creek. Macroinvertebrate field collection methods followed the same sampling methods and protocols. Samples were delivered to the EcoAnalysts, Inc., for sorting and taxonomic identification. A qualitative assessment of community structure was prepared by EcoAnalysts, Inc. in June, 2005. A total of 49 taxa were identified in the three samples. Total taxa richness in samples 1-3 was consistent among samples and the samples shared similar insect species indicating a high degree of similarity between the macroinvertebrate community at all three sites with no major differences from land use impacts between the sites.

Total taxa richness, a measure of community diversity, was consistently low in the Lindsay Creek samples. Taxa richness (the total number of mayfly, stonefly and caddis fly species) was also very low in the samples. The taxa groups are generally considered to be the more sensitive orders of aquatic macroinvertebrates, and healthy Idaho streams often find taxa richness values over 20. The taxa value was 6, 5, and 6 for the three samples. Stoneflies, the most sensitive group of insects, were absent from all three samples. No cold water taxa were observed in Lindsay Creek.

Most of the taxa richness in Lindsay Creek was found in the family Chironomidae. This is a large family of insects with a wide variety of habitat preferences and pollution tolerances. Chironomids also make up a significant proportion of the total number of insects in each sample, indicating environmental stress. The dominant functional feeding groups in all samples were those that feed on fine particulate organic matter. High dominance by this feeding group indicates environmental stress from sediment and organic inputs to the stream. The Hilsenhoff Biotic Index is a measure of community tolerance to organic enrichment. Clean low-order streams in Idaho frequently have Hilsenhoff Biotic Index values less than four, but all sites in Lindsay Creek have values over five - further evidence of system stress from sediment/organic inputs.

## Other Monitoring Data

### Caffeine

Three samples were collected from sites LZ-1 and LZ-3 on April 4, 2005 and analyzed for the presence of caffeine as an indicator of septic system influence. The two samples and a duplicate quality assurance sample were all measured to be below the practical quantification limit of 0.5 micrograms per liter ( $\mu\text{g/L}$ ) and were reported as negative for the presence of caffeine.

Additional water samples were taken on August 1, 2005 at sites LZ-1, LZ-3, and LZ-4 to assess whether caffeine concentrations exist at lower concentrations than the previous analysis could detect. The presence of caffeine was detected at all three sites, including the trip blank and laboratory method blank (Table 12). The practical quantification limit for this sampling effort was 1.0 nanogram per liter ( $\text{ng/L}$ ).

**Table 12. Caffeine data summary (August 1, 2005).**

Location	Concentration ( $\text{ng/L}$ )
LZ-1 Monitoring Site	8
LZ-3 Monitoring Site	11
LZ-4 Monitoring Site	20
Trip Blank	5
Lab Method Blank	3

In accordance with the project quality assurance plan, the data should not be qualified to report unless the positive results are greater than or equal to five times the amount of the highest reported blank concentration (U.S.EPA 1999b). This means a value of 25  $\text{ng/L}$  or greater was needed to accurately qualify that sample. As such, the available caffeine data collected during the August sampling is not conclusive to validate septic system drain field effects on Lindsay Creek.

### MBAS (Surfactants)

Further analysis into determining whether septic systems are affecting Lindsay Creek was conducted on October 6, 2005 by completing sampling and analysis for methylene blue active substances (MBAS). MBAS are key ingredients in common detergents. A negative detection must consider that the surfactants typically attach to soil particles and will not travel far. Nevertheless, a positive detection of surfactants can be used to identify whether septic system drain fields are affecting the creek.

Sites LZ-1, 3, 4 were sampled for MBAS. Laboratory results for all three samples were below the practical quantification limit of 0.05 mg/L and were reported as no detectable concentration present.

### Nitrogen Isotope Analysis

Organic nitrogen within the soil, commercial fertilizers, animal or human waste, and precipitation are common sources of nitrogen to surface and ground water. Each of these nitrate source categories has a distinguishable isotopic signature (Clark and Fritz 1997). Table 13 shows the typical range of  $^{15}\text{N}$  values in parts per thousand (per mil) for nitrogen sources.

**Table 13. General range of  $^{15}\text{N}$  values from nitrogen sources.**

Source of Nitrogen	Range (per mil)
Commercial Fertilizer	-4 to +3
Organic nitrogen in soil	+4 to +9
Human or animal waste	+10

During August 2005, surface water samples were analyzed for stable isotope ratios in an effort to identify the source of nitrogen to Lindsay Creek. Results from the sampling are displayed in Table 14.

**Table 14. Nitrogen isotope and nitrate-nitrogen data summary.**

Site Location	$^{15}\text{N}$ Value (per mil)	$\text{NO}_3\text{-N}$ Concentration (mg/L)
LZ-1	10.6	4.5
LZ-3	8.5	3.5
LZ-4	11.1	6.3
LZ-6	6.9	0.36

Isotopes are atoms whose nuclei have the same atomic number but a different mass number. Nitrogen has two common stable isotopes,  $^{14}\text{N}$  and  $^{15}\text{N}$ , and all nitrogen compounds contain both isotopes; however, the relative abundance of either isotope can vary depending on the source of nitrogen. These variations are useful for tracing nitrogen cycling that occurs within and around a watershed.

As nitrogen compounds are passed up the food chain, the lighter isotopes are flushed in urine and the heavier isotopes are retained. Nitrogen in animal waste is hydrolyzed to ammonia and then converted to nitrate. During this process more of the heavy isotope is concentrated in the resulting nitrates. When various sources of nitrogen compounds are mixed together in surface runoff or in a body of water, the ratio of light to heavy ( $^{14}\text{N}$ : $^{15}\text{N}$ ) nitrogen isotopes in the water can be used to estimate the relative contributions of the different sources.

Values shown in Table 14 are indicative of inorganic, mixed, and organic sources of nitrogen. The range of  $^{15}\text{N}$  values is assumed to vary with position in the watershed as land use and the magnitude of different sources changes. For example, in the upper plateau of the watershed the application of fertilizer to non-irrigated crops and a mix of organic and inorganic nitrogen seem more abundant than in the lower sections of the watershed, where values indicate an organic source of nitrogen, which may be originating from livestock manure.

### Chlorine

Total chlorine residual concentrations are not to exceed 0.019 mg/L as a Criterion Continuous Concentration (CCC) or 0.011 mg/L as a Criterion Maximum Concentration (CMC) for surface waters with an aquatic life beneficial use (IDAPA 58.01.02.210.01).

To determine whether chlorine concentrations in Lindsay Creek are exceeding the allowable criteria, four samples from two sites (LZ-1 and LZ-4) were collected and analyzed for total chlorine concentrations on January 27, 2006. All four samples analyzed were below the detection limit.

### Other Reports

A 1997 Idaho Division of Environmental Quality groundwater report summarized a study of nitrate-nitrite concentrations in private wells located near Lindsay Creek (IDEQ 1997). In 1998 the study continued evaluation of several of the wells that were found to have high levels of nitrite-nitrate concentrations. Five wells were sampled that were located near Lindsay Creek. Table 15 shows the nitrite-nitrate concentrations from the study.

**Table 15. Nitrite-nitrate concentrations in private wells located near Lindsay Creek.**

Site	1997 Nitrite-Nitrate Concentration (mg/L)	1988 Nitrite-Nitrate Concentration (mg/L)
#1	0.008	0.023
#2	18.3	5.32
#3	10.3	6.99
#4	1.33	1.22
#5	6.37	7.99

The 1998 study concluded that the high nitrite-nitrate concentrations found in the original samples collected from the wells were persistent. The highest concentration was found in a shallow 16 foot deep well, while the lowest concentration occurred in a drilled well 320 feet deep. These two wells are approximately 40 feet apart from each other. The report indicated that bank recharge and proximity to Lindsay Creek itself may be influencing the elevated nitrite-nitrate concentrations that were observed in the private wells.

### Conclusions

*E. coli* bacteria concentrations measured in samples collected from Lindsay Creek were above the secondary contact recreation water quality standard criterion set by the state of Idaho. Monitoring conducted in April of 2005 indicates that the development of a bacteria TMDL is needed to comply with Idaho water quality standards. Potential sources include livestock, septic systems, pets, and wildlife.

Temperature data collected during the 2001-2002 monitoring season showed no violations of the instantaneous maximum of 22 °C allowed in Idaho water quality standards. Diurnal temperature data was collected from August 14, 2005 through August 21, 2005 at site LZ-1 to assess stream temperatures when ambient air temperatures were assumed to be the highest. On August 21, 2005, the maximum diurnal stream temperature was 18.28 °C, the daily average was 16.1 °C, and the maximum daily ambient air temperature was 104 °F, indicating a temperature TMDL is not needed for Lindsay Creek.

Instantaneous dissolved oxygen concentrations measured in Lindsay Creek during the 2001-2002 season exceeded 6.0 mg/L at all times. Diurnal monitoring conducted at site LZ-1 during August, the hottest period of 2005, verified that dissolved oxygen levels are being sustained at levels above the 6.0 mg/L required by the state water quality standards.

The dominant functional feeding groups identified in Lindsay Creek are those that feed on fine particulate organic matter. High dominance by this feeding group indicates possible environmental stress from organic inputs to the stream. Nitrogen concentrations in the groundwater indicate impacts are occurring to ground water quality causing nitrogen concentrations to exceed the ground water manage action threshold for nitrate nitrite in ground water. There are no indications that total phosphorus or nitrite-nitrate concentrations have seasonality, as values remained constant with the exception of the individual spike events noted. A nutrient TMDL will be developed to initiate protective ground water quality management actions, reduce nitrogen loading to the creek, and address the effects on the cold water aquatic life in the creek.

Suspended sediment concentration data are not available for Lindsay Creek. Elevated turbidity values mirrored elevated total suspended solids on the same sampling dates. Sites LZ-1, LZ-2, LZ-3, and LZ-5 were above 50 NTU on the same occasion of heavy tilling of a field prior to 0.50 inches of precipitation. Site LZ-6 was above 50 NTU on August 27, 2001. Site LZ-3 was above 50 NTU on January 3, 2002 and January 28, 2002. Measured turbidity values at site LZ-4 did not exceed 22.0 NTU (Appendix B).

Based on the concept that a TMDL is only required to address pollution that is caused by pollutants, it is recommended that the listings for flow alteration and habitat alteration in Lindsay Creek be moved from Section 5 to Section 4c of the 2004/2006 Integrated Report.

## 2.5 Data Gaps

Additional monitoring of *E. coli* bacteria concentrations in Lindsay Creek may provide data to more accurately target problem locations for management of *E. coli* bacteria. An assessment of whether *E. coli* bacteria enter Lindsay Creek through ground water upwelling should be conducted in future re-assessments to verify assumptions used in the development of the TMDL.

Elevated nutrient concentrations documented during the 2001-2002 monitoring season are a concern, but are not affecting in-stream dissolved oxygen concentrations based on the current dissolved oxygen data. Macroinvertebrate populations suggest Lindsay Creek may be organically enriched. Nitrogen isotope analysis indicates the nitrogen found in samples collected from Lindsay Creek are from an organic and inorganic origin. Monitoring of private water wells in 1988 and 1997 show elevated levels of nitrogen are in the area's ground water. A better understanding of the origin of the nitrogen detected may determine the appropriate control or management program to address the nitrogen.

Future re-assessment work within the watershed should attempt to determine the nitrogen and *E. coli* bacteria concentrations in the seepage from Mann's Reservoir when possible. A discharge profile by month would help better understand any seasonality that may occur as a result of the fluctuating pool levels in the reservoir.

### 3. Subbasin Assessment–Pollutant Source Inventory

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#### 3.1 Sources and Transport of Pollutants

There are no known point sources that discharge to Lindsay Creek at this time.

##### Bacteria

Nonpoint sources of bacteria in the Lindsay Creek watershed include livestock, septic systems, pets and wildlife. Manure from pastures, rangeland, corrals and yards is the most manageable source of bacteria since it can be collected, diverted or moved before it reaches the creek. *E. coli* bacteria are typically in manure or water that has been in contact with manure. Manure is flushed into the creek in a variety of ways, most commonly by rain water, snow melt, or runoff. Manure is deposited directly into the creek if animals have free access to the creek. Bacteria can be carried to the creek with storm water from roads when manure is tracked onto the road. Cattle guards placed across the creek and used as bridges can cause manure to drop from trailers and trucks.

Though bacteria typically do not live long enough to travel far underground, septic system drain fields can be a source of bacteria if placed in close proximity to the creek. The results of the caffeine and methylene blue active substances analysis should have been more conclusive if drain fields were placed too close to the creek for bacteria treatment. Nitrogen can originate in septic system drain fields and travel far longer distances than bacteria since nitrogen is a chemical rather than a live organism.

##### Nutrients

In agricultural areas, the application of fertilizers to crops is a source of nutrients to subsurface waters as well as to Lindsay Creek through direct runoff. Increased soil erosion from tillage operations may add both phosphorous and nitrogen directly to the stream and also indirectly through streambed deterioration. Bank destruction as well as soil compaction contributes to increased runoff as water loses the ability to infiltrate soils properly. Waste from domestic animals and livestock may also contribute excess nutrients.

Transport of nutrients to a creek takes place through rain events, subsequent runoff, groundwater, drainage networks, and industrial and waste effluents. Nutrients received by a water body can be taken up by aquatic vegetation (macrophytes), algae, and microorganisms; sorbed to organic and inorganic particles in the water and sediment; amassed or recycled in the sediment; or transformed and released as a gas from the water body (U.S.EPA 1999a).



## **4. Subbasin Assessment – Summary of Past and Present Pollution Control Efforts**

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Modern pollution control efforts in the Lindsay Creek watershed have focused on implementation of existing rules and regulations associated with livestock management and human health sanitation.

Recently, cattle businesses have been confronted with changing state environmental laws and cattle business owners have either made the operational changes, quit the business, or are working with the Idaho Department of Agriculture to make improvements and meet the requirements of state environmental law.

Cultivated agricultural practices have focused on production and agricultural stewardship of the land. The Nez Perce County Soil Conservation District is unaware of local agricultural producers' efforts to adopt agricultural best management practices to specifically protect water quality in the watershed (Herman 2005).



## 5. Total Maximum Daily Load(s)

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A Total Maximum Daily Load calculates the allowable amount of a pollutant that can be in the water body according to state water quality standards. The allowable amount of the pollutant is called the pollutant load capacity. Once the load capacity is calculated it is distributed or allocated amongst the sources of the pollutant in the watershed.

There are two kinds of pollutant sources: point sources and nonpoint sources. Point sources get a waste load allocation; nonpoint sources get a load allocation. Since there are no point sources in the Lindsay Creek watershed, there is no waste load allocation. Background is considered part of the load allocation, but it is not available for distribution.

A margin of safety is required to account for uncertainties used in the measurement, analysis, or calculation of the load capacity. The margin of safety may be conservative assumptions, or added as a separate quantity in the TMDL calculation.

The total maximum daily load (TMDL) can be written as an equation:

**Load Capacity = Margin of Safety + Load Allocation + Waste load Allocation**

A total maximum daily load is usually only required for water bodies that do not meet state water quality standards. Once the allowable loads are calculated, current loads also need to be calculated so load reductions are recognized and completed by the sources.

The load capacity must be based on critical conditions, the conditions when water quality standards are most likely to be violated. If protective under critical conditions, the load capacity will be protective under all conditions.

The load calculation is a product of pollutant concentration and water flow, whether it is the allowable pollutant concentration as per state standards, or the existing pollutant concentration found in samples collected from the water body. The critical condition is usually in the summer when the pollutant load stays the same but the flow in the creek is lower.

### 5.1 *E. coli* Bacteria TMDL

#### Target

*E. coli* bacteria in Lindsay Creek are currently above the concentration allowed by the Idaho state water quality standards based on the data presented in Section 2.4.

The Idaho water quality standard for *E. coli* bacteria, used as the target for the development of the TMDL, is a geometric mean of 126 *E. coli* organisms per 100 milliliters using five samples taken every three to five days over a thirty-day period (IDAPA 58.01.02.251.02).

### Load Capacity

The *E. coli* bacteria load capacity for Lindsay Creek is calculated using the geometric mean of 126 *E. coli* organisms per 100 milliliters using five samples taken over a thirty day period. The load capacity is expressed as a concentration (cfu/100 ml) because it is difficult to calculate a mass load due to several variables (i.e. temperature, moisture conditions, flow) that influence the die-off rate of *E. coli* bacteria in the environment (EPA 2001).

### Estimates of Existing Pollutant Loads

Livestock, pets and septic system drain fields are the most likely sources of *E. coli* bacteria found in Lindsay Creek. Potential for these sources to contribute to the bacteria load is greatest from livestock and pets based on the information collected from the caffeine and methylene blue active substances analyses. The individual percent load contribution from each nonpoint source cannot be determined from the limited data available at this time.

### Load Allocation

Bacteria are living organisms that have an associated die-off rate. The die-off rate fluctuates with varying water quality and atmospheric conditions (U.S.EPA 2001). Flow and temperature dictate the actual mass of bacteria in the water and complicate the load allocation process because of the continuous and constant fluctuation of flow and temperature that occurs during any given time period. To simplify this process, the allocation is expressed in terms of the geometric mean of 126 cfu/100 ml found in Idaho's Water Quality Standards.

Allocations were not developed for specific source loads (i.e. tributaries). Instream allocations are developed for the LZ-1 monitoring site, based on bacteriological data collected during the month of April 2005, whereby the geometric mean was computed and assessed against Idaho's numeric criterion set forth to protect the secondary contact recreation designated beneficial use.

Table 16 lists the existing *E. coli* bacteria concentrations found in April of 2005 at the lowest monitoring station in the watershed, the secondary contact recreation geometric mean capacity, the loading allocation, and the reduction in *E. coli* bacteria concentrations that must occur to meet the load allocation.

The *E. coli* bacteria total maximum daily load for Lindsay Creek allocates a gross 30-day concentration to all nonpoint sources of *E. coli* bacteria upstream from the LZ-1 control point. As such, sources extending upstream from this location must be managed to reduce the instream *E. coli* bacteria concentrations by 240 cfu/100 ml, or 66%. To ensure that the criterion is not exceeded, this allocation will apply to any other 30-day time period since secondary contact recreation can occur at any time.

**Table 16. Load allocation<sup>1</sup> for *E. coli* bacteria in Lindsay Creek, April 2005 data.**

Location (Control Point)	Existing Load (#/100 ml)	Load Capacity (#/100 ml)	Load Allocation (#/100 ml)	Load Reduction (#/100 ml)
LZ-1	366 cfu/100 ml	126 cfu/100 ml	126 cfu/100 ml	240 cfu/100 ml or 66 percent

<sup>1</sup> Expressed in terms of an allowable concentration (mass/volume).

### Margin of Safety

The establishment of a TMDL requires that a Margin of Safety (MOS) be identified to account for uncertainty. An MOS is expressed as either an implicit or explicit portion of a water body's loading capacity that is reserved to allow for uncertainty about the relationship between the pollutant loads and the quality of the receiving water body. The MOS is not allocated to any sources of a pollutant.

Two implicit conservative assumptions have been incorporated into this TMDL and should be used as a margin of safety. An implicit conservative assumption used in the calculation of the load capacity is that dilution from groundwater discharged to the creek is not available at any point within the watershed. Base flow in the watershed is supported almost entirely from groundwater discharges (IASCD 2002). Groundwater sources typically contain very few *E. coli*, and dilution attributed to ground water flow could be used to increase the load capacity. Ground water was not identified and made available for additional load capacity in the load capacity calculations.

The second implicit conservative assumption is in the critical time period when beneficial uses are not fully supported. No allowance was provided for periods of time when beneficial uses are being attained, instead the allocation is provided year round.

If it is determined that groundwater discharging to Lindsay Creek is contributing excessive concentrations of *E. coli* bacteria, an explicit MOS may be needed.

### Seasonal Variation

Total maximum daily loads must be established with consideration of seasonal variation. *E. coli* bacteria data generated from the 2001-2002 monitoring season do not suggest a seasonal trend at the established monitoring sites.

Forty-six percent of the samples collected at the LZ-1 site exceeded Idaho's instantaneous criterion (576 cfu/100 ml) for the periods of May 2001 through September 2001 and December 2001 through February 2002. LZ-1 was in violation of the water quality standard (geometric mean criterion) during the month of April 2005. Eighty-five percent of the

samples collected at the LZ-2 site exceeded Idaho's instantaneous criterion at least once per month from March 2001 through February 2002. Samples collected at site LZ-3 exceeded Idaho's instantaneous criterion from April 2001 through January 2002. Samples collected from site LZ-4 exceeded the Idaho instantaneous criterion on three continuous sampling dates from June 2001 through July 2001, but were below the criterion the remainder of the season. Samples collected from the LZ-5 site exceeded Idaho's instantaneous criterion in May, June, July, and December. Samples collected from the LZ-6 site exceeded Idaho's instantaneous criterion between July 2001 through October 2001 and in January of 2002 (Appendix B).

This total maximum daily load addresses a critical time period that will ensure in-stream *E. coli* concentrations are reduced to the identified load allocation. Therefore, the effects of seasonal variation are built into the load allocation.

### Critical Time Period

The *E. coli* bacteria allocation applies to any 30-day period annually since secondary contact recreation may occur at any time of year. This allocation ensures water quality standards are attained for the protection of public health. Table 17 shows the critical time period for bacteria.

**Table 17. Critical time period for the *E. coli* bacteria TMDL.**

Pollutant	Critical Period
<i>E. coli</i> Bacteria	Year Round

### Background

Background has been incorporated with all other sources into the gross nonpoint source allocation.

### Reserve for Growth

A growth reserve is not included in this total maximum daily load. The load capacity has been allocated to the existing nonpoint sources currently in the watershed. Future sources will need to acquire a load allocation from existing allocations unless the load capacity is increased since the total maximum daily load is directly related to water quality standards (i.e. the allocation is the numeric criterion allowed by state water quality standards).

## 5.2 Nutrient TMDL

### Target

In Idaho, a narrative water quality standard is used to protect cold water aquatic life beneficial uses from excessive nutrients. Idaho's narrative standard for nutrients states "surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses" (IDAPA 58.01.02.200.06).

Ground water flow to Lindsay Creek is significant year round. Nitrogen concentrations in ground water are typically measured in its two forms as nitrite plus nitrate as nitrogen (Nitrite+Nitrate-N). Nitrite ( $\text{NO}_2$ ) is a compound that is short an oxygen molecule comparatively, and when exposed to oxygen changes to nitrate ( $\text{NO}_3$ ). Considering that Lindsay Creek nutrient concentrations can only be as low as the concentrations in the ground water that feed it, the target used to develop the total maximum daily load is based on a concentration considered to be normal for Idaho groundwater. Idaho reports that naturally occurring concentrations of nitrite plus nitrate, ( $\text{NO}_2 + \text{NO}_3$ ) typically do not exceed 2 mg/L and concentrations exceeding this level are considered to be outside the range of natural conditions (IDWR 1995).

### Load Capacity

The nitrate plus nitrite as nitrogen load capacity has been developed for each month using monthly average flows and concentrations from the 2001-2002 monitoring season. The monthly load capacities are expressed in pounds per month (Table 18).

### Estimates of Existing Pollutant Load

Provided in Table 18 are the existing nitrite+nitrite-N loads for the LZ-1 control point, based on instream monitoring data from the 2001-2002 monitoring season. The existing load established for February is based on three sampling events from February 2001 and February 2002, while the other months are based on average flows and concentrations from the two sampling events that took place during the month.

The equation below describes how the existing loads were generated. For the purpose of this TMDL, one month is equivalent to 30 days and was used consistently to develop the loading analyses.

Existing load (pounds per month) = average monthly concentration (mg/L)\* average monthly flow (cfs)\* 5.39 \* 30 days

Where: 5.39 = Conversion factor (converts equation results to pounds per day)

### Load Allocation

The load allocation will be applied to the lowest monitoring station in the watershed. LZ-1 will be used as a control point and all sources upstream are required a reduction in the current load to meet the load allocation at the control point.

Table 18 lists the existing nitrite+nitrate-N concentrations found during the 2001-2002 monitoring season by month at the lowest monitoring station in the watershed, the load capacity, load allocation, and the load reduction in nitrite+nitrate-N concentrations that must occur to meet the load allocation.

**Table 18. Nitrite+nitrate-N loadings for the Lindsay Creek control point.**

<b>Month</b>	<b>Average Concentration (mg/L)</b>	<b>Ave Flow (cfs)</b>	<b>Existing Load (lbs/month)</b>	<b>Load Capacity (lbs/month)</b>	<b>Load Allocation (lbs/month)</b>	<b>Load Reduction (%)</b>
<b>January</b>	6.70	3.44	3728	1113	1057	72
<b>February</b>	6.33	4.25	4351	1374	1305	70
<b>March</b>	6.15	4.61	4588	1492	1417	69
<b>April</b>	5.45	4.92	4338	1592	1512	65
<b>May</b>	5.70	3.64	3353	1177	1118	67
<b>June</b>	3.45	3.52	1963	1138	1081	45
<b>July</b>	6.35	3.31	3403	1072	1018	70
<b>August</b>	6.05	2.28	2232	738	701	69
<b>September</b>	6.80	2.32	2547	749	712	72
<b>October</b>	5.80	3.16	2968	1023	972	67
<b>November</b>	6.20	3.20	3203	1033	982	69
<b>December</b>	6.45	3.62	3774	1170	1112	71

### Margin of Safety

A margin of safety is required to account for uncertainties used in the measurement, analysis, or calculation of the load capacity and is added as a separate quantity in the TMDL calculation. For the nitrogen total maximum daily load, a margin of safety was deducted from

the load capacity to account for the uncertainties and variability associated with in-stream measurements, field sampling methods, and laboratory analyses.

Common data quality indicators, such as the relative percentage difference (RPD), provide a useful tool to measure the precision of duplicate measurements, a quality control practice that assures reliable and precise data are used for the development of total daily maximum loads. The equation below illustrates how the relative percent difference is calculated. The average relative percent difference for the nitrite+nitrate-N samples was 0.46%. This means that the actual and duplicate concentrations were within 0.46% of one another, on average, during the 2001-2002 monitoring season.

Based on the RPD of the associated data sets, it is believed that the 5% explicit margin of safety (0.1 mg/L deduction from the target) addresses the uncertainty and variability used to develop the nitrogen TMDL.

$$\text{Relative Percent Difference} = ((X1 - X2)/(X1 + X2)/2) * 100$$

Where:        X1 = Larger of the two observed values  
                  X2 = Smaller of the two observed values

#### Seasonal Variation/Critical Time Period

Ground water contribution to Lindsay Creek is significant year round. The nutrient total maximum daily load will apply year round.

#### Background

Background has been included in the load capacity since this total maximum daily load applied a gross allocation for all sources above the compliance point. Background is also applied as the target for the load allocation based on ground water concentrations entering Lindsay Creek.

#### Reserve for Growth

A growth reserve has not been established for this nutrient total maximum daily load. Allowance for future growth is not suggested until reductions in nitrite plus nitrate as nitrogen occur and full support of cold water aquatic life beneficial use has been restored.

### 5.3 Implementation Strategies

Idaho Code 39-3611 and 39-3612 provides guidance on the development and implementation of total maximum daily loads in Idaho. The guidance contained in code relies on participation and assistance of watershed advisory groups and designated management agencies.

### Reasonable Assurance

Nonpoint sources will be managed by applying the combination of authorities the state has included in the Idaho Nonpoint Source Management Plan (IDEQ 1999). Section 319 of the Federal Clean Water Act requires each state to submit to the EPA a management plan for controlling pollution from nonpoint sources within the state. Idaho's authority for implementing the Idaho Nonpoint Source Management Plan has been certified by the Idaho Attorney General. The plan has been submitted to and approved by the Environmental Protection Agency as complying with Section 319 of the Clean Water Act.

Nonpoint source pollutant controls or best management practices determined to be ineffective in achieving the desired load reductions are subject to the Feedback Loop process or adaptive management to ensure load reductions are achieved, IDAPA 58.01.02.350. The feedback loop provides for water quality improvements and maintenance through best management practice installation, evaluation and modification. Implementing the feedback loop to modify best management practices until water quality standards are met results in compliance with the water quality standards.

### Time Frame

A schedule for implementation of Best Management Practices, pollution control strategies, assessment reporting dates, and evaluation progress will be developed and included in the Lindsay Creek TMDL Implementation Plan. Based on such assessments and evaluations, implementation strategies for TMDLs may need to be modified if monitoring shows that the water quality standards are not being met.

### Approach

This TMDL focuses on implementation of load allocations for *E. coli* bacteria and nutrients. The bioassessment of the sampled macroinvertebrate population within the creek suggests an abundance of fine organic matter. The fine organic matter (most likely livestock manure) is probably a source of bacteria and organic nutrients. The inorganic nitrogen entering Lindsay Creek through shallow ground water and springs is most likely fertilizer.

Restoration of the creek's riparian area and establishment of creek buffers will filter out the fine organic matter entering the creek and most likely reduce *E. coli* bacteria and nutrient concentrations in the creek. Use of water troughs, livestock fences, and controlling the drainage from properties with animal wastes may be the most cost effective method to reduce the *E. coli* bacteria and fine organic matter from entering the creek.

The sources of organic nitrogen in the shallow ground water and springs entering Lindsay Creek need to be investigated and reductions and control methods developed and applied.

## Responsible Parties

Idaho Code 39-3612 states designated management agencies are to use TMDL processes for achieving water quality standards. The Department of Environmental Quality will rely on the designated management agencies to implement pollution control measures or best management practices for pollutant sources they identify as priority.

The Department of Environmental Quality also recognizes the authorities and responsibilities of local, city, and county governments as well as applicable state and federal agencies and will enlist their involvement and authorities for protecting water quality through implementation of Idaho Administrative Procedures Act 58.01.02 and Clean Water Act Section 401.

The designated state agencies listed below are responsible for assisting and providing technical support for the development of specific implementation plans, and other appropriate support to water quality projects. General responsibilities for Idaho designated management agencies are:

- Idaho Soil Conservation Commission: Grazing and Agriculture.
- Idaho Department of Agriculture: Aquaculture and Animal Feeding Operations.
- Idaho Department of Transportation: Public Roads.
- Idaho Department of Lands: Timber Harvest, Oil and Gas Exploration, and Mining.
- Idaho Department of Water Resources: Stream Channel Alteration activities.
- Idaho Department of Environmental Quality: All other activities.

## Monitoring Strategy

A permanent control point for water quality monitoring has been established at the LZ-1 monitoring site. LZ-1 will be used for long term comprehensive monitoring to determine whether the watershed is in compliance with Idaho WQS and fully supporting its secondary contact recreation and cold water aquatic life designations.

Idaho Code 39-3611 requires the Department of Environmental Quality to review and evaluate each Idaho TMDL, supporting assessment, implementation plan and all available data periodically at intervals no greater than five years. Such reviews are to be conducted using the Beneficial Use Reconnaissance Program protocol and the Water Body Assessment Guidance methodology to determine beneficial use attainability and status and whether state water quality standards are being achieved.

Idaho Code 39-3621 requires designated agencies, in cooperation with the appropriate land management agency, to ensure best management practices are monitored for their effect on water quality. The monitoring results should be presented to the Department of Environmental Quality on a schedule agreed to between the designated agency and the Department. The designated management agency should report the effectiveness of the

measures or practices implemented to the Department in the form of load reductions applicable to the TMDL.

Pollutant load reductions gained by the application of pollutant controls and best management practices will be monitored by the Department of Environmental Quality through reports provided by Designated Management Agencies. Information reported will be compiled and tracked over time to provide measurable pollutant load reductions relative to the total maximum daily load allocations.

## 5.4 Conclusions

Bacteria and nutrient total daily maximum loads have been developed for the Lindsay Creek watershed (Table 19). The bacteria TMDL allocates a gross concentration to all nonpoint sources of *E. coli* bacteria upstream from the LZ-1 control point. As such, sources extending upstream from this location must be managed to reduce the instream *E. coli* bacteria concentrations by 240 cfu/100 ml, a 66% reduction. A growth reserve is not included in this total maximum daily load. The load capacity has been allocated to the existing nonpoint sources currently in the watershed.

The *E. coli* bacteria allocation applies to any 30-day period annually since secondary contact recreation may occur at any time of year. This allocation ensures water quality standards are attained for the protection of public health. Future sources will need to acquire a load allocation from existing allocations unless the load capacity is increased.

The nutrient TMDL allocates a gross monthly loading to all nonpoint sources of nitrogen upstream from the control point. Nonpoint sources extending upstream must be managed to reduce instream nitrite+nitrate-N concentrations by 45%-72% (dependant upon the month), or a 67% annual reduction. A growth reserve has not been established for this nutrient total maximum daily load. Allowance for future growth is not suggested until reductions in nitrite+ nitrate-N occur and full support of cold water aquatic life beneficial use has been restored.

A TMDL can only address pollutants that can be quantified. It is recommended that the Section 5 listings of flow alteration and habitat alteration be changed and moved to section 4c of the 2006 Idaho Integrated Report since TMDLs can only developed for pollutants that can be quantified.

**Table 19. Summary of assessment outcomes.**

<b>Water Body Segment/AU #</b>	<b>Pollutant</b>	<b>TMDL(s) Completed</b>	<b>Recommended Changes to Integrated Report</b>	<b>Justification</b>
Lindsay Creek 17060306CL003_02 & _03	Bacteria	Yes	Move to Section 4a	TMDL Completed
Lindsay Creek 17060306CL003_02 & _03	Temperature	No	Remove as Pollutant	Data demonstrates that the applicable WQS is being met
Lindsay Creek 17060306CL003_02 & _03	Dissolved Oxygen	No	Remove as Pollutant	Data demonstrates that the applicable WQS is being met
Lindsay Creek 17060306CL003_02 & _03	Sediment	No	Remove as Pollutant	Data demonstrates that the applicable WQS is being met
Lindsay Creek 17060306CL003_02 & _03	Nutrients	Yes	Move to Section 4a	TMDL Completed
Lindsay Creek 17060306CL003_02 & _03	Flow Alteration	No	Move to Section 4c	Pollutant vs. Pollution
Lindsay Creek 17060306CL003_02 & _03	Habitat Alteration	No	Move to Section 4c	Pollutant vs. Pollution

## 5.5 Public Participation

This TMDL has been developed with the assistance of the Lindsay Creek Watershed Advisory Group. The Watershed Advisory Group was recommended by the Clearwater Basin Advisory Group in January 2006, appointed by the Department Director in February 2006, and organized in April 2006.

The Watershed Advisory Group represents agriculture, local government, federal government, the Nez Perce Tribe, recreation, forestry, point source discharges, environmental, mining, livestock, and residential interests. The Watershed Advisory Group has met, and through their established operating procedures, provided concurrence to complete this draft TMDL.

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## Glossary

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<b>305(b)</b>	Refers to section 305 subsection “b” of the Clean Water Act. 305(b) generally describes a report of each state’s water quality, and is the principle means by which the U.S. Environmental Protection Agency, Congress, and the public evaluate whether U.S. waters meet water quality standards, the progress made in maintaining and restoring water quality, and the extent of the remaining problems.
<b>§303(d)</b>	Refers to section 303 subsection “d” of the Clean Water Act. 303(d) requires states to develop a list of <i>water bodies</i> that do not meet water quality standards. This section also requires total maximum daily loads (TMDLs) be prepared for listed waters. Both the list and the TMDLs are subject to U.S. Environmental Protection Agency approval.
<b>Algae</b>	Non-vascular (without water-conducting tissue) aquatic plants that occur as single cells, colonies, or filaments.
<b>Alluvium</b>	Unconsolidated recent stream deposition.
<b>Ambient</b>	General conditions in the environment. In the context of water quality, ambient waters are those representative of general conditions, not associated with episodic perturbations, or specific disturbances such as a wastewater outfall (Armantrout 1998, EPA 1996).
<b>Anadromous</b>	Fish, such as salmon and sea-run trout, that live part or the majority of their lives in the salt water but return to fresh water to spawn.
<b>Anthropogenic</b>	Relating to, or resulting from, the influence of human beings on nature.
<b>Aquatic</b>	Occurring, growing, or living in water.
<b>Aquifer</b>	An underground, water-bearing layer or stratum of permeable rock, sand, or gravel capable of yielding of water to wells or springs.

<b>Assemblage (aquatic)</b>	An association of interacting populations of organisms in a given <i>water body</i> ; for example, a fish assemblage, or a benthic macroinvertebrate assemblage (also see Community) (EPA 1996).
<b>Assessment Database (ADB)</b>	The ADB is a relational database application designed for the U.S. Environmental Protection Agency for tracking water quality assessment data, such as use attainment and causes and sources of impairment. States need to track this information and many other types of assessment data for thousands of water bodies and integrate it into meaningful reports. The ADB is designed to make this process accurate, straightforward, and user-friendly for participating states, territories, tribes, and basin commissions.
<b>Assessment Unit (AU)</b>	A segment of a water body that is treated as a homogenous unit, meaning that any designated uses, the rating of these uses, and any associated causes and sources must be applied to the entirety of the unit.
<b>Assimilative Capacity</b>	The ability to process or dissipate pollutants without ill effect to beneficial uses.
<b>Beneficial Use</b>	Any of the various uses of water, including, but not limited to, aquatic biota, recreation, water supply, wildlife habitat, and aesthetics, which are recognized in water quality standards.
<b>Beneficial Use Reconnaissance Program (BURP)</b>	A program for conducting systematic biological and physical habitat surveys of <i>water bodies</i> in Idaho. BURP protocols address lakes, reservoirs, and wadeable streams and rivers
<b>Best Management Practices (BMPs)</b>	Structural, nonstructural, and managerial techniques that are effective and practical means to control nonpoint source pollutants.
<b>Best Professional Judgment</b>	A conclusion and/or interpretation derived by a trained and/or technically competent individual by applying interpretation and synthesizing information.

<b>Biological Integrity</b>	1) The condition of an aquatic community inhabiting unimpaired <i>water bodies</i> of a specified habitat as measured by an evaluation of multiple attributes of the aquatic biota (EPA 1996). 2) The ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the natural habitats of a region (Karr 1991).
<b>Biota</b>	The animal and plant life of a given region.
<b>Biotic</b>	A term applied to the living components of an area.
<b>Clean Water Act (CWA)</b>	The Federal Water Pollution Control Act (commonly known as as the Clean Water Act), as last reauthorized by the Water Quality Act of 1987, establishes a process for states to use to develop information on, and control the quality of, the nation's water resources.
<b>Coliform Bacteria</b>	A group of bacteria predominantly inhabiting the intestines of humans and animals but also found in soil. Coliform bacteria are commonly used as indicators of the possible presence of pathogenic organisms (also see Fecal Coliform Bacteria).
<b>Community</b>	A group of interacting organisms living together in a given place.
<b>Criteria</b>	In the context of water quality, numeric or descriptive factors taken into account in setting standards for various pollutants. These factors are used to determine limits on allowable concentration levels, and to limit the number of violations per year. EPA develops criteria guidance; states establish criteria.
<b>Cubic Feet per Second</b>	A unit of measure for the rate of flow or discharge of water. One cubic foot per second is the rate of flow of a stream with a cross-section of one square foot flowing at a mean velocity of one foot per second. At a steady rate, once cubic foot per second is equal to 448.8 gallons per minute and 10,984 acre-feet per day.

<b>Designated Uses</b>	Those water uses identified in state water quality standards that must be achieved and maintained as required under the Clean Water Act.
<b>Discharge</b>	The amount of water flowing in the stream channel at the time of measurement. Usually expressed as cubic feet per second (cfs).
<b>Dissolved Oxygen (DO)</b>	The oxygen dissolved in water. Adequate DO is vital to fish and other aquatic life.
<b><i>E. coli</i></b>	Short for <i>Escherichia Coli</i> , <i>E. coli</i> are a group of bacteria that are a subspecies of coliform bacteria. Most <i>E. coli</i> are essential to the healthy life of all warm-blooded animals, including humans. Their presence is often indicative of fecal contamination.
<b>Ecosystem</b>	The interacting system of a biological community and its non-living (abiotic) environmental surroundings.
<b>Environment</b>	The complete range of external conditions, physical and biological, that affect a particular organism or community.
<b>Exceedance</b>	A violation (according to DEQ policy) of the pollutant levels permitted by water quality criteria.
<b>Existing Beneficial Use or Existing Use</b>	A beneficial use actually attained in waters on or after November 28, 1975, whether or not the use is designated for the waters in Idaho's <i>Water Quality Standards and Wastewater Treatment Requirements</i> (IDAPA 58.01.02).
<b>Fecal Coliform Bacteria</b>	Bacteria found in the intestinal tracts of all warm-blooded animals or mammals. Their presence in water is an indicator of pollution and possible contamination by pathogens (also see Coliform Bacteria).
<b>Feedback Loop</b>	In the context of watershed management planning, a feedback loop is a process that provides for tracking progress toward goals and revising actions according to that progress.
<b>Flow</b>	See Discharge.

<b>Fluvial</b>	In fisheries, this describes fish whose life history takes place entirely in streams but migrate to smaller streams for spawning.
<b>Fully Supporting</b>	In compliance with water quality standards and within the range of biological reference conditions for all designated and existing beneficial uses as determined through the <i>Water Body Assessment Guidance</i> (Grafe et al. 2002).
<b>Fully Supporting Cold Water</b>	Reliable data indicate functioning, sustainable cold water biological assemblages (e.g., fish, macroinvertebrates, or algae), none of which have been modified significantly beyond the natural range of reference conditions (EPA 1997).
<b>Geographical Information Systems (GIS)</b>	A georeferenced database.
<b>Geometric Mean</b>	A back-transformed mean of the logarithmically transformed numbers often used to describe highly variable, right-skewed data (a few large values), such as bacterial data.
<b>Gradient</b>	The slope of the land, water, or streambed surface.
<b>Ground Water</b>	Water found beneath the soil surface saturating the layer in which it is located. Most ground water originates as rainfall, is free to move under the influence of gravity, and usually emerges again as stream flow.
<b>Habitat</b>	The living place of an organism or community.
<b>Headwater</b>	The origin or beginning of a stream.

<b>Hydrologic Unit</b>	One of a nested series of numbered and named watersheds arising from a national standardization of watershed delineation. The initial 1974 effort (USGS 1987) described four levels (region, subregion, accounting unit, cataloging unit) of watersheds throughout the United States. The fourth level is uniquely identified by an eight-digit code built of two-digit fields for each level in the classification. Originally termed a cataloging unit, fourth field hydrologic units have been more commonly called subbasins. Fifth and sixth field hydrologic units have since been delineated for much of the country and are known as watershed and subwatersheds, respectively.
<b>Hydrologic Unit Code (HUC)</b>	The number assigned to a hydrologic unit. Often used to refer to fourth field hydrologic units.
<b>Hydrology</b>	The science dealing with the properties, distribution, and circulation of water.
<b>Impervious</b>	Describes a surface, such as pavement, that water cannot penetrate.
<b>Inorganic</b>	Materials not derived from biological sources.
<b>Instantaneous</b>	A condition or measurement at a moment (instant) in time.
<b>Intermittent Stream</b>	1) A stream that flows only part of the year, such as when the ground water table is high or when the stream receives water from springs or from surface sources such as melting snow in mountainous areas. The stream ceases to flow above the streambed when losses from evaporation or seepage exceed the available stream flow. 2) A stream that has a period of zero flow for at least one week during most years.
<b>Limnology</b>	The scientific study of fresh water, especially the history, geology, biology, physics, and chemistry of lakes.
<b>Load Allocation (LA)</b>	A portion of a <i>water body's</i> load capacity for a given pollutant that is given to a particular nonpoint source (by class, type, or geographic area).

<b>Load(ing)</b>	The quantity of a substance entering a receiving stream, usually expressed in pounds or kilograms per day or tons per year. Loading is the product of flow (discharge) and concentration.
<b>Loading Capacity (LC)</b>	A determination of how much pollutant a <i>water body</i> can receive over a given period without causing violations of state water quality standards. Upon allocation to various sources, and a margin of safety, it becomes a total maximum daily load.
<b>Macroinvertebrate</b>	An invertebrate animal (without a backbone) large enough to be seen without magnification and retained by a 500µm mesh (U.S. #30) screen.
<b>Macrophytes</b>	Rooted and floating vascular aquatic plants, commonly referred to as water weeds. These plants usually flower and bear seeds. Some forms, such as duckweed and coontail ( <i>Ceratophyllum sp.</i> ), are free-floating forms not rooted in sediment.
<b>Margin of Safety (MOS)</b>	An implicit or explicit portion of a <i>water body's</i> loading capacity set aside to allow the uncertainty about the relationship between the pollutant loads and the quality of the receiving <i>water body</i> . This is a required component of a total maximum daily load (TMDL) and is often incorporated into conservative assumptions used to develop the TMDL (generally within the calculations and/or models). The MOS is not allocated to any sources of pollution.
<b>Mean</b>	Describes the central tendency of a set of numbers. The arithmetic mean (calculated by adding all items in a list, then dividing by the number of items) is the statistic most familiar to most people.
<b>Median</b>	The middle number in a sequence of numbers. If there are an even number of numbers, the median is the average of the two middle numbers. For example, 4 is the median of 1, 2, 4, 14, 16; and 6 is the median of 1, 2, 5, 7, 9, 11.
<b>Milligrams per liter (mg/L)</b>	A unit of measure for concentration in water, essentially equivalent to parts per million (ppm).

<b>Monitoring</b>	A periodic or continuous measurement of the properties or conditions of some medium of interest, such as monitoring a <i>water body</i> .
<b>Mouth</b>	The location where flowing water enters into a larger <i>water body</i> .
<b>National Pollution Discharge Elimination System (NPDES)</b>	A national program established by the Clean Water Act for permitting point sources of pollution. Discharge of pollution from point sources is not allowed without a permit.
<b>Nitrogen</b>	An element essential to plant growth, and thus is considered a nutrient.
<b>Nodal</b>	Areas that are separated from focal and adjunct habitats, but serve critical life history functions for individual native fish.
<b>Nonpoint Source</b>	A dispersed source of pollutants, generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint sources are without a discernable point or origin. They include, but are not limited to, irrigated and non-irrigated lands used for grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.
<b>Not Fully Supporting</b>	Not in compliance with water quality standards or not within the range of biological reference conditions for any beneficial use as determined through the <i>Water Body Assessment Guidance</i> (Grafe et al. 2002).
<b>Not Fully Supporting Cold Water</b>	At least one biological assemblage has been significantly modified beyond the natural range of its reference condition (EPA 1997).
<b>Nuisance</b>	Anything which is injurious to the public health or an obstruction to the free use, in the customary manner, of any waters of the state.

<b>Nutrient</b>	Any substance required by living things to grow. An element or its chemical forms essential to life, such as carbon, oxygen, nitrogen, and phosphorus. Commonly refers to those elements in short supply, such as nitrogen and phosphorus, which usually limit growth.
<b>Nutrient Cycling</b>	The flow of nutrients from one component of an ecosystem to another, as when macrophytes die and release nutrients that become available to algae (organic to inorganic phase and return).
<b>Organic Matter</b>	Compounds manufactured by plants and animals that contain principally carbon.
<b>Orthophosphate</b>	A form of soluble inorganic phosphorus most readily used for algal growth.
<b>Pathogens</b>	Disease-producing organisms (e.g., bacteria, viruses, parasites).
<b>Perennial Stream</b>	A stream that flows year-around in most years.
<b>Periphyton</b>	Attached microflora (algae and diatoms) growing on the bottom of a <i>water body</i> or on submerged substrates, including larger plants.
<b>pH</b>	The negative $\log_{10}$ of the concentration of hydrogen ions, a measure which in water ranges from very acid (pH=1) to very alkaline (pH=14). A pH of 7 is neutral. Surface waters usually measure between pH 6 and 9.
<b>Phosphorus</b>	An element essential to plant growth, often in limited supply, and thus considered a nutrient.
<b>Point Source</b>	A source of pollutants characterized by having a discrete conveyance, such as a pipe, ditch, or other identifiable “point” of discharge into a receiving water. Common point sources of pollution are industrial and municipal wastewater.
<b>Pollutant</b>	Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.

<b>Pollution</b>	A very broad concept that encompasses human-caused changes in the environment which alter the functioning of natural processes and produce undesirable environmental and health effects. This includes human-induced alteration of the physical, biological, chemical, and radiological integrity of water and other media.
<b>Population</b>	A group of interbreeding organisms occupying a particular space; the number of humans or other living creatures in a designated area.
<b>Protocol</b>	A series of formal steps for conducting a test or survey.
<b>Quality Assurance (QA)</b>	A program organized and designed to provide accurate and precise results. Included are the selection of proper technical methods, tests, or laboratory procedures; sample collection and preservation; the selection of limits; data evaluation; quality control; and personnel qualifications and training. The goal of QA is to assure the data provided are of the quality needed and claimed (Rand 1995, EPA 1996).
<b>Quality Control (QC)</b>	Routine application of specific actions required to provide information for the quality assurance program. Included are standardization, calibration, and replicate samples. QC is implemented at the field or bench level (Rand 1995, EPA 1996).
<b>Quantitative</b>	Descriptive of size, magnitude, or degree.
<b>Reconnaissance</b>	An exploratory or preliminary survey of an area.
<b>Reference</b>	A physical or chemical quantity whose value is known, and thus is used to calibrate or standardize instruments.

<b>Reference Condition</b>	1) A condition that fully supports applicable beneficial uses with little affect from human activity and represents the highest level of support attainable. 2) A benchmark for populations of aquatic ecosystems used to describe desired conditions in a biological assessment and acceptable or unacceptable departures from them. The reference condition can be determined through examining regional reference sites, historical conditions, quantitative models, and expert judgment (Hughes 1995).
<b>Reference Site</b>	A specific locality on a <i>water body</i> that is minimally impaired and is representative of reference conditions for similar <i>water bodies</i> .
<b>Representative Sample</b>	A portion of material or water that is as similar in content and consistency as possible to that in the larger body of material or water being sampled.
<b>Riparian</b>	Associated with aquatic (stream, river, lake) habitats. Living or located on the bank of a <i>water body</i> .
<b>River</b>	A large, natural, or human-modified stream that flows in a defined course or channel, or a series of diverging and converging channels.
<b>Runoff</b>	The portion of rainfall, melted snow, or irrigation water that flows across the surface, through shallow underground zones (interflow), and through ground water to creates streams.
<b>Sediments</b>	Deposits of fragmented materials from weathered rocks and organic material that were suspended in, transported by, and eventually deposited by water or air.
<b>Species</b>	1) A reproductively isolated aggregate of interbreeding organisms having common attributes and usually designated by a common name. 2) An organism belonging to such a category.
<b>Spring</b>	Ground water seeping out of the earth where the water table intersects the ground surface.

<b>Stream</b>	A natural water course containing flowing water, at least part of the year. Together with dissolved and suspended materials, a stream normally supports communities of plants and animals within the channel and the riparian vegetation zone.
<b>Stream Order</b>	Hierarchical ordering of streams based on the degree of branching. A first-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher order streams result from the joining of two streams of the same order.
<b>Storm Water Runoff</b>	Rainfall that quickly runs off the land after a storm. In developed watersheds the water flows off roofs and pavement into storm drains that may feed quickly and directly into the stream. The water often carries pollutants picked up from these surfaces.
<b>Stressors</b>	Physical, chemical, or biological entities that can induce adverse effects on ecosystems or human health.
<b>Subbasin</b>	A large watershed of several hundred thousand acres. This is the name commonly given to 4 <sup>th</sup> field hydrologic units (also see Hydrologic Unit).
<b>Subbasin Assessment (SBA)</b>	A watershed-based problem assessment that is the first step in developing a total maximum daily load in Idaho.
<b>Subwatershed</b>	A smaller watershed area delineated within a larger watershed, often for purposes of describing and managing localized conditions. Also proposed for adoption as the formal name for 6 <sup>th</sup> field hydrologic units.
<b>Surface Fines</b>	Sediments of small size deposited on the surface of a streambed or lake bottom. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 605 mm depending on the observer and methodology used. Results are typically expressed as a percentage of observation points with fine sediment.

<b>Surface Runoff</b>	Precipitation, snow melt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of nonpoint source pollutants in rivers, streams, and lakes. Surface runoff is also called overland flow.
<b>Surface Water</b>	All water naturally open to the atmosphere (rivers, lakes, reservoirs, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors that are directly influenced by surface water.
<b>Suspended Sediments</b>	Fine material (usually sand size or smaller) that remains suspended by turbulence in the water column until deposited in areas of weaker current. These sediments cause turbidity and, when deposited, reduce living space within streambed gravels and can cover fish eggs or alevins.
<b>Taxon</b>	Any formal taxonomic unit or category of organisms (e.g., species, genus, family, order). The plural of taxon is taxa (Armantrout 1998).
<b>Total Maximum Daily Load (TMDL)</b>	A TMDL is a <i>water body's</i> loading capacity after it has been allocated among pollutant sources. It can be expressed on a time basis other than daily if appropriate. Sediment loads, for example, are often calculated on an annual bases. $TMDL = Loading\ Capacity = Load\ Allocation + Wasteload\ Allocation + Margin\ of\ Safety$ . In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several <i>water bodies</i> and/or pollutants within a given watershed.
<b>Total Dissolved Solids</b>	Dry weight of all material in solution in a water sample as determined by evaporating and drying filtrate.

<b>Total Suspended Solids (TSS)</b>	The dry weight of material retained on a filter after filtration. Filter pore size and drying temperature can vary. American Public Health Association Standard Methods (Greenborg, Clescevi, and Eaton 1995) call for using a filter of 2.0 micron or smaller; a 0.45 micron filter is also often used. This method calls for drying at a temperature of 103-105 °C.
<b>Tributary</b>	A stream feeding into a larger stream or lake.
<b>Vadose Zone</b>	The unsaturated region from the soil surface to the ground water table.
<b>Wasteload Allocation (WLA)</b>	The portion of receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. Wasteload allocations specify how much pollutant each point source may release to a <i>water body</i> .
<b>Water Body</b>	A stream, river, lake, estuary, coastline, or other water feature, or portion thereof.
<b>Water Column</b>	Water between the interface with the air at the surface and the interface with the sediment layer at the bottom. The idea derives from a vertical series of measurements (oxygen, temperature, phosphorus) used to characterize water.
<b>Water Pollution</b>	Any alteration of the physical, thermal, chemical, biological, or radioactive properties of any waters of the state, or the discharge of any pollutant into the waters of the state, which will or is likely to create a nuisance or to render such waters harmful, detrimental, or injurious to public health, safety, or welfare; to fish and wildlife; or to domestic, commercial, industrial, recreational, aesthetic, or other beneficial uses.
<b>Water Quality</b>	A term used to describe the biological, chemical, and physical characteristics of water with respect to its suitability for a beneficial use.
<b>Water Quality Criteria</b>	Levels of water quality expected to render a body of water suitable for its designated uses. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, or industrial processes.

<b>Water Quality Limited</b>	A label that describes <i>water bodies</i> for which one or more water quality criterion is not met or beneficial uses are not fully supported. Water quality limited segments may or may not be on a §303(d) list.
<b>Water Quality Limited Segment (WQLS)</b>	Any segment placed on a state's §303(d) list for failure to meet applicable water quality standards, and/or is not expected to meet applicable water quality standards in the period prior to the next list. These segments are also referred to as "§303(d) listed."
<b>Water Quality Management Plan</b>	A state or area-wide waste treatment management plan developed and updated in accordance with the provisions of the Clean Water Act.
<b>Water Quality Standards</b>	State-adopted and EPA-approved ambient standards for <i>water bodies</i> . The standards prescribe the use of the <i>water body</i> and establish the water quality criteria that must be met to protect designated uses.
<b>Water Table</b>	The upper surface of ground water; below this point, the soil is saturated with water.
<b>Watershed</b>	1) All the land which contributes runoff to a common point in a drainage network, or to a lake outlet. Watersheds are infinitely nested, and any large watershed is composed of smaller "subwatersheds." 2) The whole geographic region which contributes water to a point of interest in a <i>water body</i> .
<b>Waterbody Identification Number (WBID)</b>	A number that uniquely identifies a <i>water body</i> in Idaho ties in to the Idaho Water Quality Standards and GIS information.



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